

POPULAR SCIENCE

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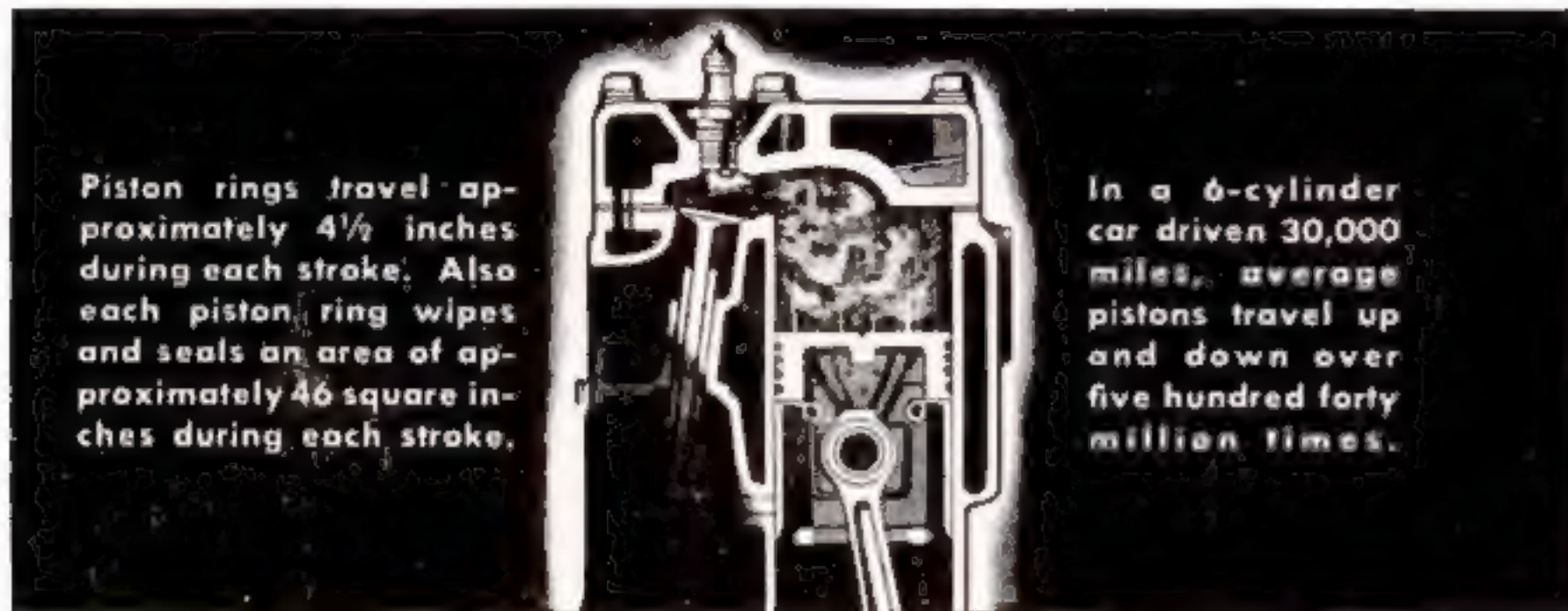
NEW INVENTIONS
MECHANICS
THE HOME WORKSHOP
MONEY MAKING IDEAS
350 PICTURES

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FREDERICK
WITTHACK
7

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New Engines for Old

WITH MIRACULOUS NEW-TYPE EXPANDER PISTON RINGS



50 Times a Second the pistons flash up and down when you drive at about sixty miles an hour. When cylinders become worn, they are larger at the top than at the bottom. That means the piston rings must expand and contract fifty times a second to seal the cylinder walls

properly. Ordinary rings aren't equal to this terrific task, but Perfect Circle X-90 Piston Rings have solved the problem. They have an amazing ability to flex lightning-fast and seal worn cylinders, even at highest speeds. The secret? Independent spring action!

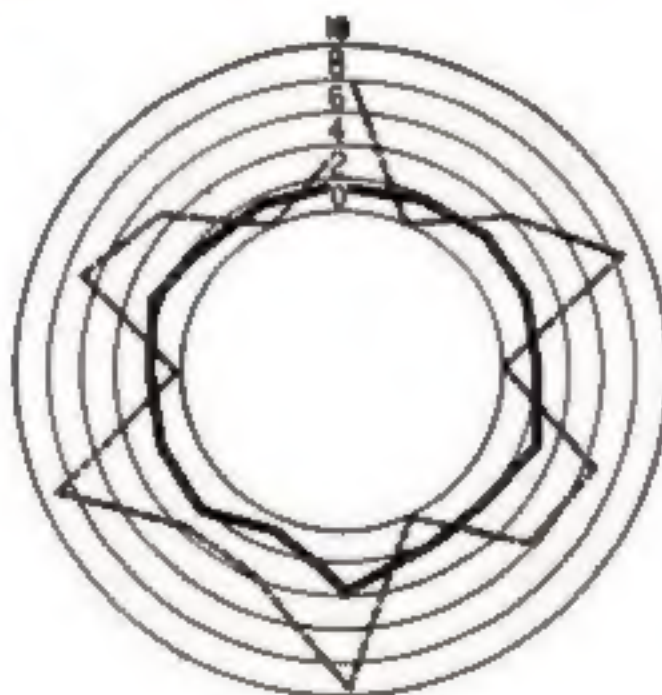


U. S. Pat. Nos. 1,414,796; 1,348,953; 2,025,334; 2,025,335; RE: 19,900

Why the X-90 Saves You Money. Six individual double-leaf springs operate independently, giving the X-90 ring amazing flexibility. Friction and piston drag are cut to the vanishing point.

The heavy black line in this pressure chart shows the uniform, circular pressure of X-90 rings. A better seal is effected. More oil and compression are saved.

The dotted line shows how old-type expander rings "stiff arm" cylinder walls. The pressure varies from 12 pounds to zero.



Free "HOW TO DOUBLE THE LIFE OF YOUR CAR"

An amazing booklet tells for the first time, in ABC language, the simple things that help you get the value out of your car that the manufacturer built into it. Also specific information on your model of car. Send the coupon now. It may save you hundreds of dollars.

PERFECT CIRCLE



Trade-mark Reg.

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PISTON RINGS • PISTON EXPANDERS

New-Car Pep and Oil Mileage Restored by PERFECT CIRCLE X-90 RINGS

AT LAST a piston ring that actually cuts piston drag! No towing the car after installation. No breaking in. It seals even badly worn cylinders. Brings back original performance and oil mileage. Doesn't paralyze even at highest speeds.



"Nopel Don't Need Oil." Increased oil mileages up to 500% amaze owners who install Perfect Circle X-90's



Old Bus Takes It in High. Worn cylinders mean lost compression. Horsepower snaps back to new-car pep with X-90 Rings



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Hagerstown, Ind., Dept. PS4, U. S. A. and
Toronto, Canada

Send me without cost or obligation your booklet, "How to Double the Life of Your Car," and information on my car.

Name.....
Address.....
City.....State.....
Make of car or truck.....Model.....
Mileage.....Trouble.....
Name of garage, mechanic, or car dealer (fill in carefully).....
Address.....

"SAFETY INTERIORS" SENSATIONAL NEW IDEA IN MOTOR CAR SAFETY!



SMOOTH... all instrument board controls are recessed...lower edge of panel is rounded...soft rubber windshield-wiper knobs.

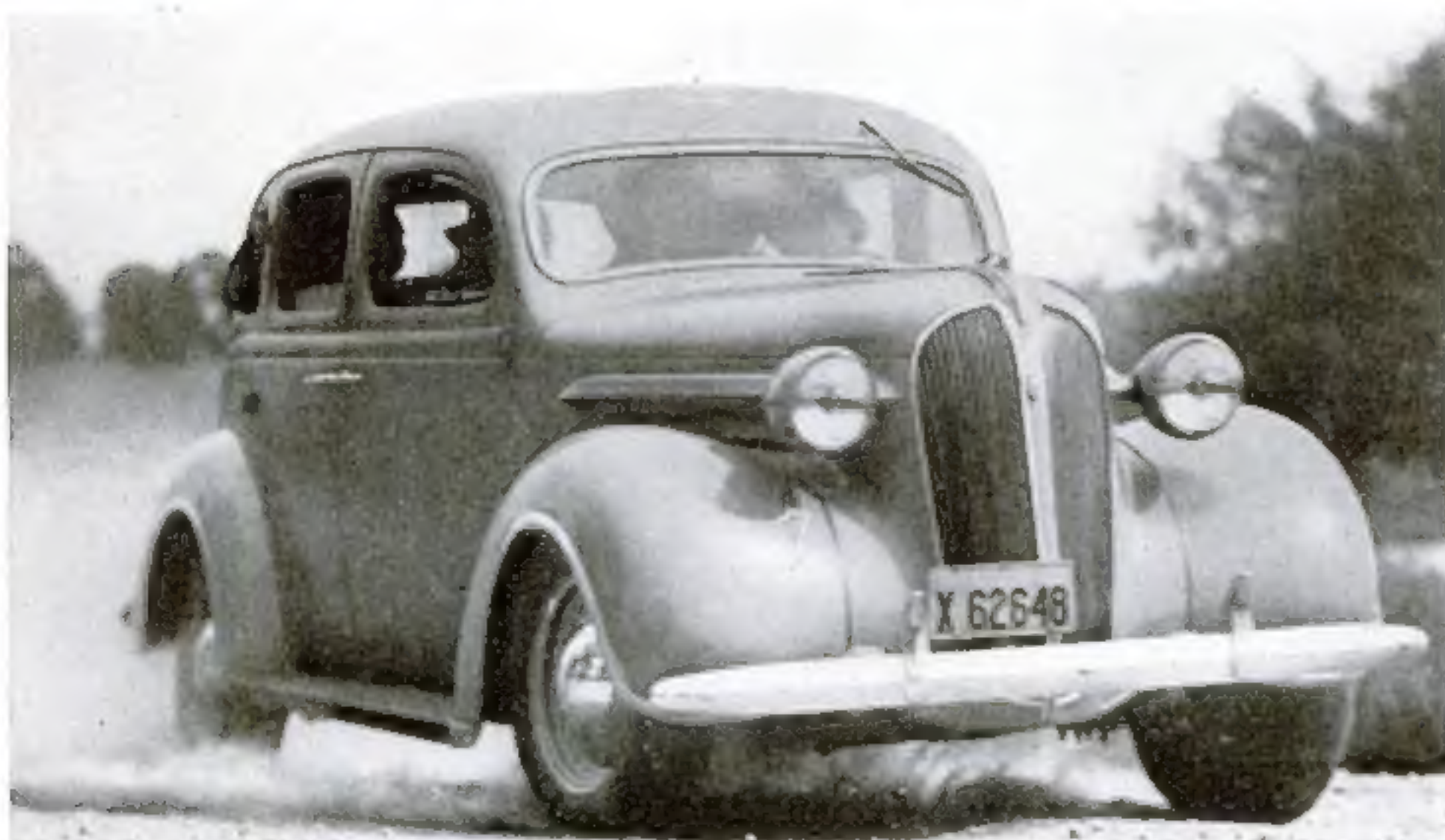
Every Detail Inside the Car Recessed or Padded or Redesigned for Protection of Passengers

HERE'S ONE of the most interesting improvements in 1937 automobiles...the handsome, new interiors of Plymouth cars...designed and planned for safety, as well as beauty.

This has been done, as a result of clinical research, to eliminate minor mishaps inside the car...bruises in case of sudden stops...torn clothing...barked knuckles.

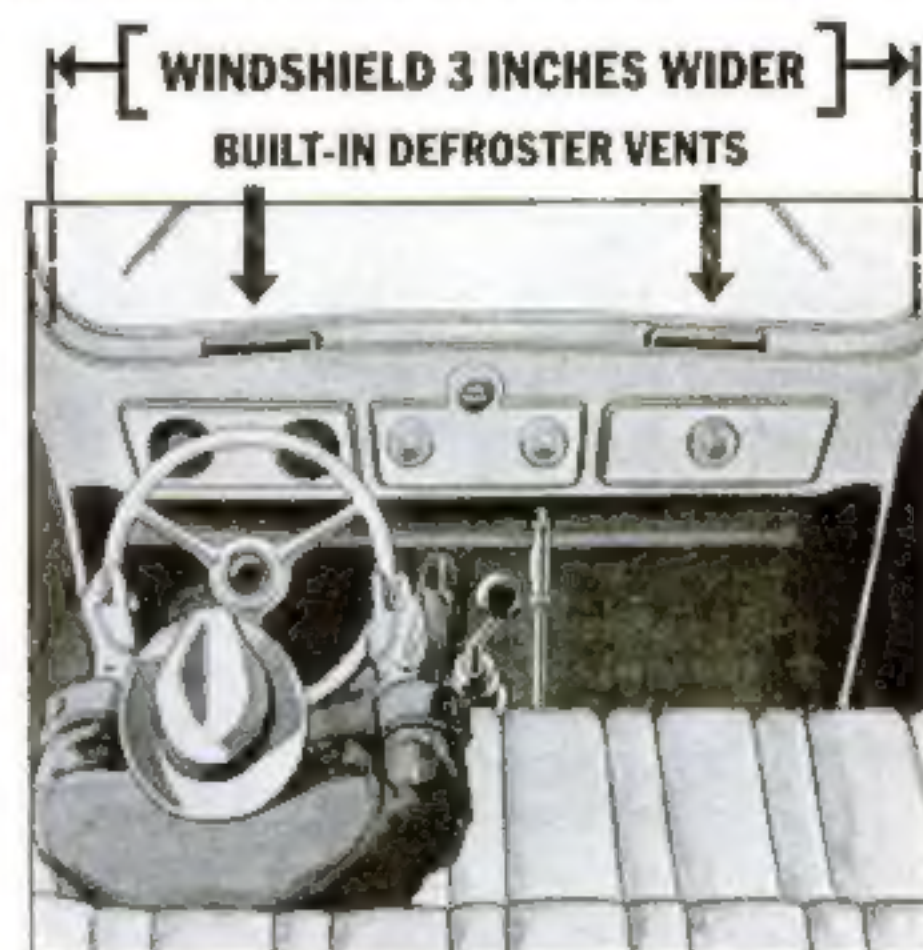


SUDDEN STOP: No harm! The deep padding of the front seat is carried over the back edge in a heavy roll that prevents bumps.



The beautiful 1937 Plymouth De Luxe Four-Door Sedan

SAFER—AND EASIER! Driving the new Plymouth is effortless. Easiest steering you have ever experienced; easy, quiet gear shifting; no sway on curves. Plus big, double-action hydraulic brakes that stop you smoothly, safely!



BETTER VISION AHEAD... the ventilating windshield is clear, and wider by 3". Warm air defroster vents built in.

WHAT MAKES A SAFE CAR

- ★ **DOUBLE-ACTION HYDRAULIC BRAKES**...self-equalizing...sure, swift, safe stops.
- ★ **ALL-STEEL BODY**...the top is one solid "stamping" of steel...walls, doors, floor are all steel reinforced with steel.
- ★ **EFFORTLESS STEERING**... responds to a touch...no sway on curves. Driving is really restful; parking's a cinch!
- ★ **NO SWAY ON CURVES**...rigid stabilizer at front end of extra-rigid frame keeps car on even keel...steady on the turns.
- ★ **SAFETY INTERIOR**... every detail carefully styled and designed for greater safety as well as beauty.



LOW FLOORS—No "hump" in rear. Wide doors. "Chair-height" seats that support your whole body properly... and permit you to ride in restful, relaxed comfort.



HEAR A WATCH TICK! Big all-steel body is sound-proofed like a modern broadcasting studio. Noise shut out...prevents nerve-strain and fatigue...another big safety factor.

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You'll discover this beautiful, new 1937 Plymouth is priced with the lowest...and offers a payment plan which will fit your budget. See your Chrysler, De Soto or Dodge dealer—for the convenient purchase terms made available by the Commercial Credit Company...terms as low as \$25 a month. **PLYMOUTH DIVISION OF CHRYSLER CORPORATION, Detroit, Mich.**

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Our Readers Say



Thank You, We'll Stick To Cows' Milk

IN A recent issue, the Man with the Net told of a machine invented by two Evansville, Ind., inventors for milking guinea pigs. Since I work in the same laboratory with these men, I am in a position to correct some of your information. First, the machine was not made to milk guinea pigs, but to milk rats. Guinea pigs can be milked by hand! Second, guinea-pig milk does not contain much more fat than cows' milk, while rats' milk contains about three times as much fat as cows' milk. —R.E.R., Evansville, Ind.



Cannon for Airplanes Become a Reality

IT SEEMED to me as if you had overlooked a new war invention when news dispatches from Spain recently mentioned the use of a rapid-fire gun, mounted aboard an airplane, that shoots high-explosive shells instead of bullets at other aircraft. I apologize for my faulty memory. Thumbing through some of my back copies of the magazine not long afterward, I came across your article, "Flying Battleships," with a description and even a diagram of what is evidently the selfsame gun (P. S. M., Dec., '34, p. 36). I was interested to reread a prediction that seems to be coming true: "Battleships of the air, spouting death from bristling cannon, will sail majestically across the skies, exchanging screaming shells and blasting one another to pieces high above the earth." —F.P.W., Milwaukee, Wis.

Who Says We Know All the Answers?

I'd like to suggest that somewhere in your magazine you publish the correct solutions to the problems that appear in Our Readers Say. Two or three months after the publication of a question, you could divulge the right answer, and so help us check up on our own solutions. —W.E.F., Bird-in-Hand, Pa.

Wants To Fiddle Around With Stringed Instruments

As a comparative newcomer to your large family of readers, I hesitate to write after reading the contributions of some who apparently have been with you since the beginning of time. However, I have one request that I would like to make: I am sure that an article on the construction of stringed instruments such as the cello would prove a practical and interesting woodworking project. I am particularly interested in the larger ones. —G.H., Jr., Spring Valley, N.Y.



A Technical Question On Insect Photography

MAYBE I'm just showing my ignorance of photography, but it seems to me there's something screwy about the way you have Lee Passmore laying for the trapdoor spider in your March issue. You say, "In one hand he holds a long flash light, directing its glare at intervals on the door of a trapdoor-spider nest. . . The other hand rests on the switch of a 'flash gun,' while a carefully trained camera waits with its shutter open, ready to catch a picture." Now, what I want to know is this: if the camera shutter is open, and Passmore keeps turning his flash light on the door of the nest for hours before the spider opens it, why isn't the image of the closed door registered faintly on the film, or at least a blur of light? Will some camera hound patiently, and in words of one syllable, explain that to me? —R.A.B., Detroit, Mich.

Well, We've Got That Girder Around the Corner!

As a structural engineer, I was interested in the problem submitted by S.A.M., Sykesville, Md., about hauling the 100-foot girder around the corner. It is solved by finding the angle at which the available space is less than for any other angle. For the corner given, this minimum space is about 105.98 feet. Allowing twice the width of the girder as extra space needed, the 100-foot girder will swing around the corner so long as it is less than three feet wide. —J.H.F., Washington, D.C.

YAH, A RINGER!



Time To Start Thinking About Keeping Cool

WITH summer coming on, how about giving us an article on the construction of a good air-conditioning unit? Something that would take care of about 5,000 cubic feet of space would suit me, and I am sure that many of your readers would appreciate such plans. Incidentally, I am making twelve mercury barometers from plans you published, and I must say that they seem to be working out well. I expect to use them for advertising purposes. —A.L.N., Miami, Fla.

This May Explain The Teapot Mystery

IN ANSWER to M.W.E.'s question of why a silver teapot holds in the heat better than a porcelain one, I'd say that it is because silver, being a good conductor, quickly rises to the temperature of the tea and then stops draining off a portion of the heat. The porcelain container, on the other hand, requires a great deal more heat to bring it up to the temperature of its contents, and therefore heat is constantly being absorbed, and the temperature of the tea lowered accordingly.

The fact that a polished surface reflects heat may be another reason for the superiority of the silver pot. —P.N., Syracuse, N.Y.

Is the Longest Way 'Round The Shortest Way Home?

IN RESPONSE to F.L.M.'s request for more problems, let's see what readers can do with this one. A man is in a rowboat one mile out in a lake whose shore line is straight. Three miles along the shore, from the point nearest the boat, is a road running at right angles to the shore, and a town is located five miles out on this road. The man can row two miles an hour, run six miles an hour through the rough country surrounding the lake, and run ten miles an hour along the road. What route should he take to reach the town in the shortest possible time? —H.E.H., Lincoln, Nebr.



He's So Good at Telepathy, He Doesn't Need a Radio

SINCE publishing that interesting article on telepathy, you probably have been swamped with letters from readers who want to tell about their own experiences or those of their friends. Well, here's mine: Several years ago, I was "keeping company" with a girl who played the piano and, as I was something of a performer on the saxophone, we often played duets together. There was one piece of music we liked particularly. Then I went away to college, and for several months forgot all about both girl and music. One evening, while I was studying, that piece of music started running through my head so plainly that I just couldn't get rid of it. The impression was so strong that I wrote to the girl, telling her about it. She wrote back that on that particular evening, just at the time the tune hit me, she had sat down at the piano and played the music, for the first time since I had left. —J.T., Canton, Ohio.

When a Live Wire Really Acts That Way

SEVERAL years ago, you published an item telling how an electric cable carrying a heavy current may squirm and kick like a fire hose, because of the electromagnetic forces set up in it. I was reminded of this recently, when an engineer friend told me that it is sometimes necessary to estimate the force exerted between two bus bars that carry heavy currents. It seems that if these bus bars are not fastened securely enough to their insulating support, they may (Continued on page 5)



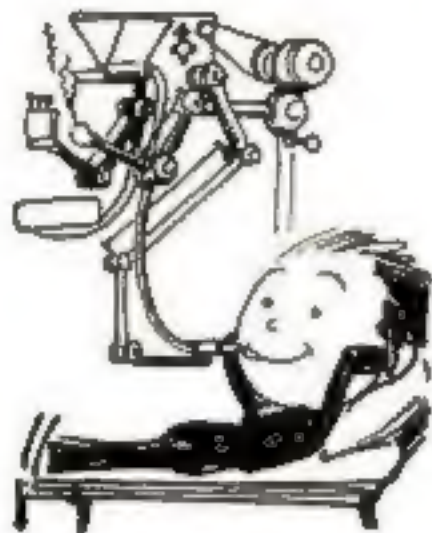
OUR READERS SAY

(Continued from page 4)

yank themselves loose. Having to tie down an electric conductor to keep it from hopping all over the place strikes me as being funny, somehow.—E.G.R., Washington, D. C.

Match Holder Draws Fire From This Reader

IN REGARD to the combination match holder and striker featured on your page of new household devices in a recent issue, I would say that if smokers are now too lazy to strike their own matches someone should invent a mechanical smoker to do the whole business for them.—J. S., San Antonio, Tex.



Peasants Will Say That This Is an Easy One

HERE'S a brain-twister I came across the other day: In a certain country, there are only two kinds of people, lords and peasants; the lords always tell the truth, while the peasants always lie. Three natives of this country met on a road. The first described himself to the second, who turned to the third and said, "He says he's a lord." The third replied, "He's not a lord; he's a peasant." The puzzle is to figure out how many of the three were lords, and how many were peasants.—A.N., Brooklyn, N. Y.

Wanted: a Simple Explanation of Calculus in 3,000 Words

AFTER reading "Our Readers Say" for ten years or so, I have come to the conclusion that there are a number of mathematics sharks among your subscribers. You have articles on chemistry, microscopy, model making, radio, etc., but I have never seen one on mathematics. Why not give us mathematicians a break and have a series of articles such as, for example, "Calculus and Its Practical Applications"? I think this would be very interesting and instructive, since calculus, I have heard, is a great time saver in innumerable places.—R.S.S., Denver, Colo.

Radium in Dental Plates Isn't Exactly New

IN A recent issue, you referred to dental molds or plates containing radioactive substances being used as a new means of treating cancer of the mouth. As a former employee in the radium department of a hospital in Glasgow, Scotland, I happen to know that this method of treatment was in use there six years ago, and is therefore not a new development. It also is employed in treating cancer of the lip.—A.M.R., S.S. Cameronia.

THE COST GIVE
A HEADACHE
WORSE 'N
TOOTHACHE
IT'S FIXIN'



Maybe His Idea Is to Build Them of Rubber

THE reason why bridges are swept away in flood-stricken areas is that they are not built on the right principles. Of course, bridges built like the present ones will be carried off by flood waters, but if they could be constructed in such a (Continued on page 6)

INVENTORS

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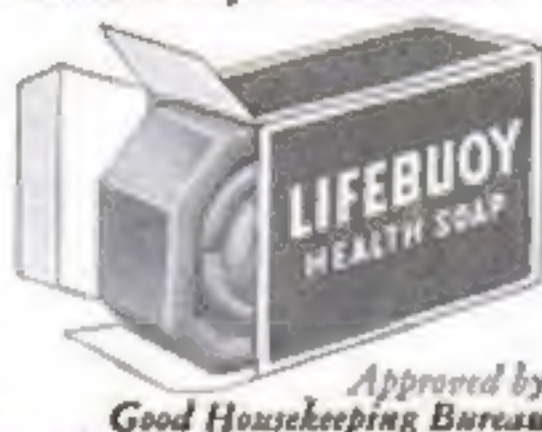
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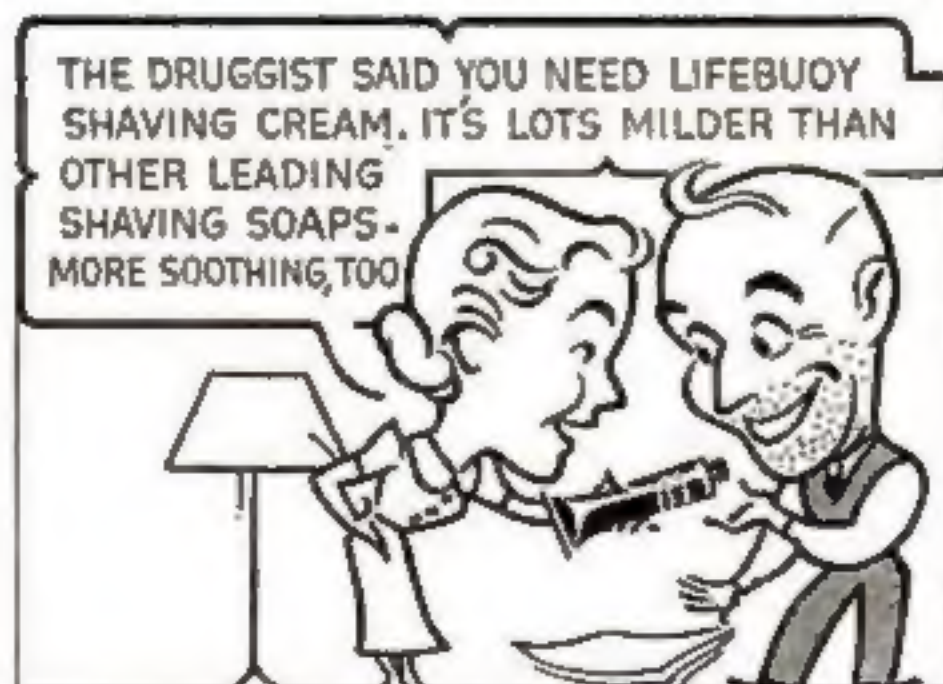
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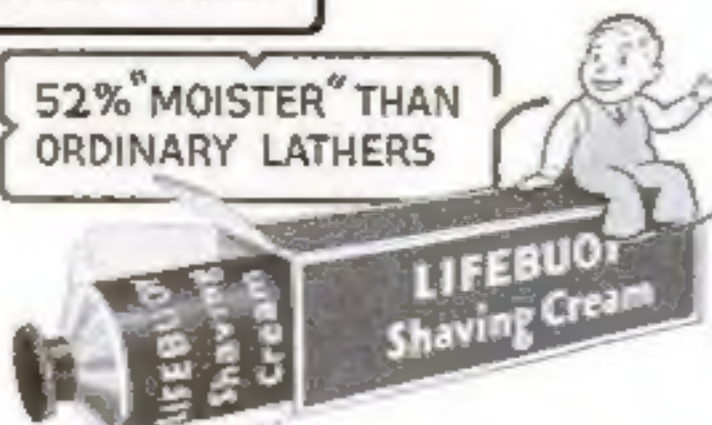


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OUR READERS SAY

(Continued from page 5)

way that they would be strong, yet flexible, I am sure that the problem would be solved, without the unnecessary expense of aluminum or "jackknife" construction.—H.C.S., Brooklyn, N. Y.

The Coffee, It Seems Had Grounds for Boiling

Mrs. E.O.C., who is perplexed by the increased activity of boiling water when coffee is added, suggests that the chemicals in the coffee lower the boiling point of the water. The explanation, however, is much simpler than that. The irregular edges of the coffee grains added to boiling water provide a starting point for the formation of steam bubbles. With something to help them form, the bubbles develop more easily and more rapidly, thus producing more violent action in the water.—D.W.A., Salt Lake City, Utah.

Might Put the Puppets Up to Monkey Business

I THINK it would be a good idea for your Home Workshop Department to give us an article telling how to make one of those quaint old instruments, the organ grinder's music box. I am sure this project would win wide approval from home-workshop fans and curio hobbyists. For my own part, I could use a hand organ very nicely to provide an appropriate background of music for my marionette show.—T.T., Cleveland, Ohio.



Why Not Invent a Machine To Invent Our Inventions?

IN A RECENT issue I noticed that telephone subscribers in Stockholm, Sweden, can obtain a taxi, the time of day, or a weather report merely by dialing certain numbers. This certainly portends the advance of a purely mechanical age when we'll all be eating a hearty meal by swallowing three food pills and learning our lessons from phonograph records that teach our "subconscious" while we sleep. What with photo-electric cells opening and closing doors for us, radios handing out baseball scores and crooning us to sleep, electricity winding our clocks, and automatic stokers feeding the furnace, I feel that it's high time somebody invented something that will make more instead of less work for everybody. Otherwise we'll soon be needing padded toothpicks to prop our eyes open, and automatic pinching machines to keep reminding us to breathe.—M.P.E., Plattsburgh, N.Y.

Just Casting About For Something New

OUR MAG is swell! I can't say I want any of its sections dropped. However, if you need a new subject, why not give us some articles on home foundry work? The Diesel torch described recently permits us to turn on the heat.—R.K., Ontonagon, Mich.

Feminine Reader Wants Easier Math Problems

YOURS is an interesting magazine, and I particularly enjoy the "Our Readers Say" page. The only fault I have to find in your publication is the fact that it leans too much toward the male sex. (Continued on page 7)

OUR READERS SAY

(Continued from page 6)

I am interested in the mathematical problems which are published, but to my dismay, after working for hours on them, I find that they cannot be worked with high-school arithmetic. Why not print some easier ones for us ladies?—G.I.K., Knoxville, Ill.

Model-Railroad Builder Prefers OO to HO

PLEASE don't take too much notice of E.K., who recently let out a cry for railroad plans in HO gauge. Just go on publishing diagrams with dimensions in full sizes; then any model-railroad enthusiast capable of constructing his own equipment can scale down to his particular gauge—whether it be O, HO, OO, or something else. I maintain that OO (four-millimeter) gauge has HO backed off the map for the real rail-roader who gets his measurements from actual trains or from drawings with full-scale dimensions. Try scaling these measurements down to HO gauge and you'll find yourself using an unwieldy reducing factor of 17/128 inches to the foot, instead of the simple four millimeters to each foot for OO. Millimeter rules are easily procured and that is all the extra equipment you need to start work in this simple OO scale.—F.W.S., Victoria, B.C., Canada.

AW, I THOUGHT YOU SAID H₂O!



Requests Information On a New Stenciling Process

SOMEONE told me recently that there was a good way to make stencils for reproducing printing by attaching paper stencils to silk bolting cloth held taut in a frame, so that the ink comes through the silk and outlines the letters or designs. This method, I understand, does away with the necessity for ties or bridges to join the detached "island" parts of the stencil, as in the central section of the letter O. Why not give us an article in the Home Workshop section on this process?—B.B.W., Portland, Me.

Thinks Index Would Settle Some Arguments

MANY times, when I get into an argument with a friend, I want to refer to some article in a back issue to settle the question. But that means I must wade and fumble through seventy-two issues to find it, for I have a six-year file of the magazine. How about publishing an index of the whole magazine, including both short and long articles as well as the Home Workshop section?—G.D.J., Capelano, Kans.



Come On and Tell Us What Science Is

FREQUENTLY I have heard science defined as "the orderly arrangement of knowledge." Here is a definition that appeals to me as being more specific: "Science is that branch of learning which links causes and effects." I don't know whether this is original with me. If not, perhaps some reader can tell me who said it first.—G.P.S., St. Paul, Minn.

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ICE KEEPS FLOWERS FROM FREEZING

"HEATING with ice" now enables freshly cut roses, sweet peas, and gardenias to be rushed safely from California gardeners to eastern florists during winter months. Carried in unheated compartments of fast transcontinental airplanes, the blooms have hitherto been subject to damage by freezing. In a scheme successfully tried out a few weeks ago by Durward F. Fisher, refrigeration specialist of the U. S. Bureau of Plant Industry, a box containing flowers is wrapped in turn with a sheet of waxed paper, thirty thicknesses of water-soaked newspaper, another sheet of waxed paper, dry newspapers, and heavy wrapping paper, just before shipment. At the frigid temperatures of high altitudes, the water in the wrapper starts to congeal—but, paradoxically, heat is liberated inside the package. Thermometer tests show that the interior temperature is held at thirty-two degrees F., two degrees above the danger point for the flowers. The explanation lies in the fact that water at the freezing temperature has to give up a certain amount of heat, known to physicists as its "heat of fusion," before it can turn into ice at exactly the same temperature. This is the source of the heat that protects the blossoms from damage. Government experiments also have been made with the process for possible use in the winter shipment of pears.

"TRICYCLE" GEAR MAKES PLANE LANDINGS SAFER

A "TRICYCLE" landing gear representing a radical departure from conventional design will be employed upon forty new planes destined for three of the country's leading airlines. Instead of being placed at the rear of the machine, the third wheel of the landing gear is fixed to the extreme forward end of the fuselage, where it offers positive protection against "nosing over," or performing a forward somersault in an imperfect landing. Planes so equipped can "fly into the ground," descending at sufficient speed for the pilot to retain full flying control, which he now momentarily loses as he "stalls," or kills his speed after leveling off for a landing. Successful tests of the new safety gear have been conducted with a small two-place machine at Washington, D. C., and with a heavier plane at Wright Field, Dayton, Ohio.

INSTRUMENT MEASURES SMOOTHNESS OF PAPER

TO MEASURE the smoothness of paper, two Wisconsin inventors have produced a scientific apparatus which combines a prism, an electric eye, and a miniature hydraulic press. The paper to be tested is pressed against the back face of a prism which reflects light onto the photo-electric cell. The closer the contact made between prism and paper, or, in other words, the smoother the paper, the lower is the intensity of the light reflected. The photo-electric cell turns this light into currents which can be recorded, thus giving an exact measure of the relative smoothness of different samples of paper.

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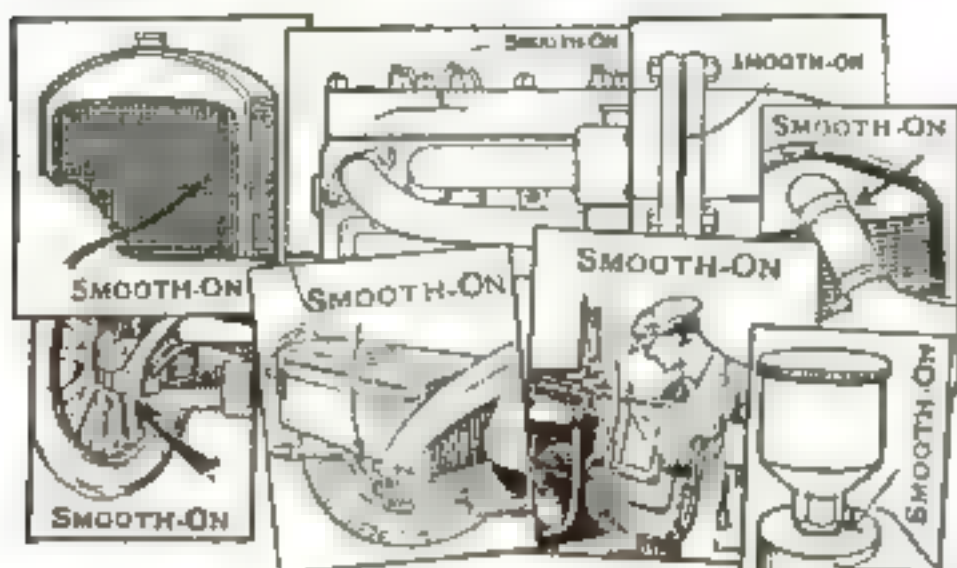
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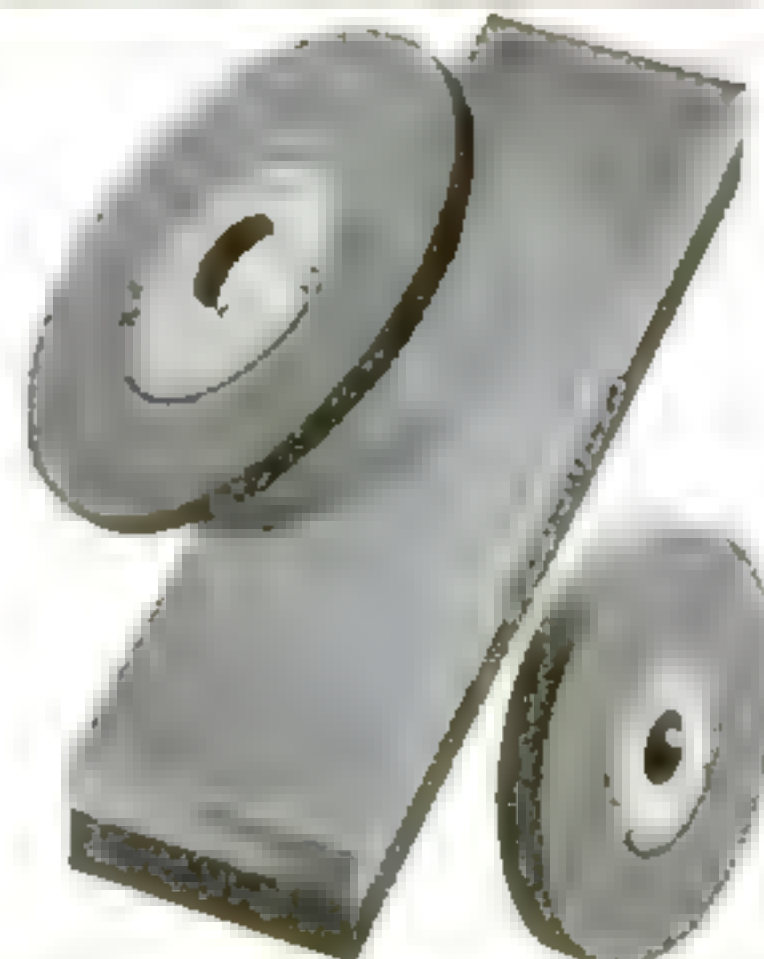
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Only letters from bonafide home study school students will be considered and these must contain the name of the school and the name of the company, or companies, for whom you have worked since graduation. (Names, however, will be deleted from the letters when published.) We also want to know the kind of course you took and the type of position you have held. Your own identity will be kept anonymous, if desired.

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COULD HARDLY READ OR WRITE

My present job is not, perhaps, a big one. But when I think of all those fellows with better educational opportunities than I ever had who have been in and out of work during the past thirty years, I know my home study was worth all I put into it.

Some of my friends say it has just been luck and perhaps they are right—or partly so. I was lucky to see the value of a course. I was lucky to spend most of my otherwise idle moments in study instead of in poolrooms. But these same people, who said I was lucky back in 1912, either could not keep up with the times or were too lazy to learn and have no jobs today.

The _____ School had a real job on its hands when it accepted me as a student of electrical engineering. I could neither read nor write to any extent and as for mathematics!... well, I could just barely add, and knew nothing whatever about long or short division or multiplication. Yes, it was a tough job—for both the School and for me, because I had never been to any school before taking the _____ Course. What I knew about reading and

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Secrets of Success

writing, I learned at home and my only school books were scientific publications.

In fact, at this time my only reason for wanting to know how to read was because I heard of Tesla's wonderful inventions and wanted to know more about them. My first reader was an article about The Tesla Coil and it gave me a thirst for more. It also made me, at the age of 12, a full-fledged electrician with several home-made wireless sets, wireless phones and a wireless power transmitter!

During the next ten years I had a job with the ——— Electric Company and got just nowhere. Perhaps I did know a lot about electricity but no one discovered the fact. Besides, I could not do sums, and, though I had many ideas, I could not put my thoughts on paper. So somehow or other I got that ——— course.

I am still an electrician, yes, and even if I have learned no more, what knowledge I have acquired is *in order*. I can work out complicated electrical problems. I have written many articles on electrical subjects and invented many devices we use in our work on the railway. I am also a radio engineer for many people in Canada and the United States.

Everything I have learned was learned at home and with money earned on the side—writing, radio work and acting as consulting engineer. I now have a beautiful country place of 100 acres (with my own laboratory) and when I look around me—at our river, our fields, our wonderful trees I think: "Yes, I am lucky." But at the same time I thank the power that made me see the value of home study and I thank Tesla, Edison and other gifted men who put their thoughts into words that we all might read, learn and by so doing, perhaps accomplish even more wonderful things than they. And I am only a dunce . . . think what men who have learned to spell and write properly in school could do with their spare moments!

Think of all the things they could learn to do. And don't forget—you fellows who cry about the tough time you are having—that to keep a job or to get one you must have something the boss can't do without. There may be thousands of good workmen, but the man that stays on the job, who gets a better one, right off the bat, is the man who knows just a wee bit more than his fellows.

I know dozens of good electricians but with most of them it's a case of having only one line. They can do *this* but they can't do *that*. They can't fix radios, bells, X-Rays, motors, meters, telephones or the hundreds of other things which are really a part of their trade and which they should know by heart. One fellow I know can wire up any kind of motor but he can't wind one!

Well, all I can say is this: you're passing up good money whenever you let time slide by without learning something new. If you find it hard to learn (as I did), try a good course. I can name many of my friends who have good jobs since taking a ——— course (on my advice) and I am glad to have their everlasting thanks for having giving them the facts.

—A.H.M., Quebec, Que., Canada.

Neglect of Home-Study Training Cost This Man \$47,424!

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SOME time ago we received a letter which every man working for a living ought to read—whether he's making \$20 a week or \$200. Here it is:

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We quote the above letter not because the man who wrote it is making a staggering salary as a result of his training, but because it illustrates so clearly the principle behind LaSalle training.

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But if training in Higher Accountancy—or Modern Salesmanship—or Business Management—or Law—or Business Correspondence—or any of a dozen other branches of business could change your forty-eight dollars into no more than \$72 a week (which is quite possible), and if you now NEGLECT to try to advance yourself through the training you need—will you not find it difficult, thirty-eight years from now, to explain to those who are dear to you why you threw away \$47,424?

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Age

Secrets of Success GOT PRACTICAL TRAINING WITH THEORY

While working as a clerk for the Oil Company, I decided to study law, which had always held my interest. Having just been married and not having much money, I could not even entertain the thought of attending any resident law school. I waded through the pages of many magazines and finally decided to enroll with a nationally-recognized extension school.

After about a year's night home study, I felt keenly the necessity of getting some experience with the practical side of law and at the same time draw a salary. After persistent effort, I was finally notified by the county recorder that there was a vacancy in his office for a booking machine operator, typist and proofreader. I taught myself to operate the typewriter, but I went to the office every Sunday and at night to learn how to operate the booking machine.

I spent one year in the recorder's office and then was offered a position as temporary secretary to a United States Attorney in the Federal Building. I craved more legal knowledge than just local and State law, so I grabbed at the opportunity. When the permanent secretary came back after a prolonged illness, I was transferred into the office of the United States Marshall and worked as outside and inside deputy. Before I had ever finished my extension law course, I took the bar examinations in Arizona and was passed by the Supreme Court of that State.

Then later, for a short period, I was "loaned out" to the office across the hall—the United States Department of Justice. I kept up my home studies in law, however, and I also studied to perfect myself in shorthand and English, as I had left grammar school in the sixth grade.

Coming to California with my wife and one boy, I became manager of a large, well-known private detective agency. While here for several years, I studied California law and procedure and was also admitted to the bar in this State. I had two boys by this time and needed a better and steadier income. I also wanted some practical experience with California criminal law. Consequently, I took the civil service examinations required by the Police Department and passed O. K. While on night duty in different valley sub-stations, I studied California law (this was before I was finally admitted to practice).

I now have a little law office and at nights study the writing of stories, articles and verse. I might mention that I will soon continue my home studies in fingerprint work as I believe a lawyer should know all about this just so nothing can be slipped over on him by experts.

I might add that I get many books in second-hand stores as well as new ones that are advertised in scientific magazines. I owe all of what little so-called success I have to home study. By teaching and digging in for the fact myself, I get it. I don't believe I would like resident college class work, even if I could afford it. The way I worked it, I got practical training with my theory and got paid while doing it.

—M.H.H., Glendale, Calif.

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NEW X-RAY PHOTOGRAPHS AID STUDY OF CELLS

HUMAN and animal tissues are being studied with X-ray photographs, through a new technique developed by Prof. Paul Lamarque, French experimenter. Biologists seeking the secrets of living matter have hitherto resorted to colored stains to distinguish clearly the various parts of animal tissue under the microscope. Instead, Prof. Lamarque takes advantage of the fact that some parts of tissue, especially the nucleus of a cell, transmit X rays more readily than other parts. The difference is so slight that ordinary X rays would not show it, so he uses "soft," less penetrating X rays instead. Since these rays are stopped even by air, he makes his shadow pictures in a vacuum chamber, using fine-grained photographic emulsion that can be enlarged greatly. Resulting X-ray photographs clearly show the cellular patterns without recourse to colored stains. The new method is declared to give laboratory workers far greater latitude in the number of different chemical reagents they may use in experiments on the behavior of cells. Another advantage is the possibility of "weighing" and identifying chemical ingredients of a cell directly by X-ray pictures, since the opacity of a substance to X rays is determined by the weight of its molecules. Practical applications for the the new technique are foreseen in medical research and in criminology, for identifying and observing the effect of various drugs and poisons, and in many other fields.

WHEAT BECOMES BREAD IN HALF AN HOUR

DURING a recent demonstration of new high-speed farm machinery at Noblesville, Ind., wheat from a grain field was cut, threshed, ground into flour, and baked into biscuits in exactly thirty-four minutes. The standing grain was cut by means of a tractor-pulled machine equipped with a thresher cylinder which removes and cleans the grain, dumps it into two-bushel sacks, and piles these four at a time in the field. The straw is blown out behind the machine spreading evenly over the field to act as fertilizer. A truck, rolling along after the combined harvester and thresher, picked up the sacks. In the demonstration, the grain was then ground and a farmer's wife turned this flour into piping hot, buttered biscuits which were back in the field where the wheat had grown in just four minutes more than half an hour after the operations started.

AUTOMATIC HORN SOUNDS AT SUDDEN STOPS

A HORN that sounds automatically when a motorist slams on the brakes in an emergency has been devised by a Connecticut inventor. The switch is attached to the brake pedal in such a manner that a quick initial movement, such as is made in putting on the brakes suddenly, sounds the horn. In stopping normally, when the brakes are applied gradually, the horn is silent. The device does not interfere with the ordinary use of the horn.

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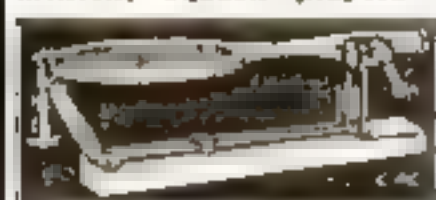


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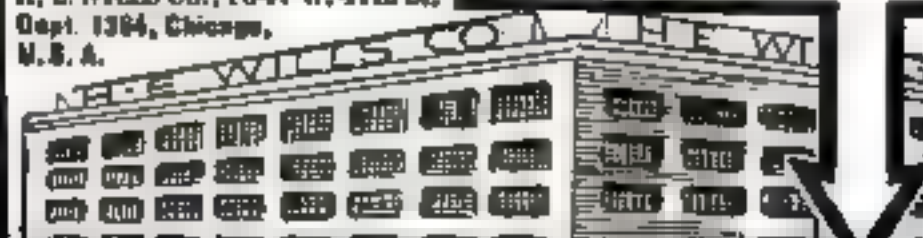
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New Ideas for HOME OWNERS

INEXPENSIVE WALL-PAPER REMOVER

AS AN AID to home decorators, a new, easily applied wall-paper remover has recently been placed on the market. Supplied in powder form, the material is simply mixed with hot water and applied to the wall paper with a brush or spray gun. According to the manufacturers, this new product penetrates to the wall almost instantly, loosening the paper in about half the time normally required by other methods. It is said to be harmless to hands, clothing, painted surfaces, and anything water alone does not affect. One package, selling for a few cents, contains enough powder to make half a gallon of the solution—a quantity said to be sufficient to treat all the walls of an average-size room.



The wall-paper remover can be applied with brush or spray gun



NEW DUAL-ACTION FUSE HAS AUTOMATIC CUT-OUT

NEEDLESS blow-outs due to the heavy current drain set up by the starting of small household motors are prevented by a new automatic fuse. Equipped with a heat-operated cut-out, the fuse breaks the circuit temporarily when a momentary overload is present, but "blows" when a continuous short circuit is to blame.

TERMITE EXTERMINATOR FOR SMALL HOMES

DESIGNED for use in combating termites and other destructive ants, a novel exterminator now available for home use feeds a special destructive sirup to the insects through a wick at the bottom of the container. Enticing to termites, the sirup is nonpoisonous to humans, and the container can be refilled simply by unscrewing the top. Eight containers are recommended as protection for the average home.



Needless blow-outs are eliminated by this fuse

SHOWER VALVE INSURES FIXED WATER TEMPERATURE

A NEW, easily installed valve for shower baths entirely eliminates the possibility of scalding due to a sudden change in water pressure. By means of a convenient control, the valve can be quickly adjusted to deliver water at any constant tempera-

ture up to 115 degrees F. The unit is especially designed for use in apartments and two-family houses where water pressure is not constant and is apt to vary the hot-cold mixture obtained with regular manually controlled valves.

METAL FLOOR SUPPORTS SIMPLIFY PLUMBING

ADJUSTABLE steel bearing plates now on the market for use as floor-beam supports in small homes simplify the problem of installing plumbing and heating ducts within the walls. Fastened to each side of the studding with nails, the metal plates do not obstruct the area between the studs, thereby eliminating the usual cutting or fitting necessary to pass the pipes when ordinary wood plates are used. Being adjustable, the steel units can be applied to any framework regardless of the span between studs. The plates can be used over concrete slabs, in place of a wood sill, or as a replacement for wood plates where plumbing is to be installed.

CABINET WATER HEATER FOR KITCHEN USE



This compact unit, which matches other kitchen equipment, houses a gas-burning water heater

DISGUISED as an attractive enameled cabinet, a new, compact automatic hot-water heater is designed for installation in the kitchen or laundry. Fitted with an easily cleaned metal top, the gas-burning unit not only blends in with existing kitchen equipment, but provides valuable additional working space. By turning a control lever, similar to that used on many modern gas ranges, the unit can easily be adjusted to provide hot water over a wide range of temperatures. Only twenty-five inches square and thirty-six inches high, the unit employs a spherical storage tank having a water capacity of twenty gallons.

EASILY APPLIED LOTION SOFTENS DRY LEATHER

WITH a new lotion now available, it is an easy matter to keep leather chairs and chair seats in the best of condition. The dressing, sold as a liquid in bottles, is simply rubbed on with a soft cloth. Penetrating below the surface, it is said to soften the leather and to prevent future cracking due to the excessive dryness of the air in most steam-heated homes. The lotion also can be used to protect luggage, hand bags, and leather-bound books and to rejuvenate leather that has become dry and hard through an accidental wetting.

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WITH A RECENTLY marketed attachment, new-type paint cans may be attached directly to spray guns, eliminating the necessity of using separate glass supply jars. Consisting of a lever-operated clamp, the new unit grips a projecting lip on the top of the paint can and holds it firmly in place. When a different color is to be used, the can may be easily removed, the gun cleaned with thinner, and the can containing the second color slipped into place. When not in use, the paint cans may be sealed simply by replacing their friction-grip covers.

PORTABLE GREENHOUSE FOR HOME GARDENERS

COMPACT and portable, a miniature greenhouse now on the market forms a valuable aid for the home gardener who desires to start small seedlings for early spring planting. Available in two sizes, the units can be obtained with either electric or oil heaters to provide convenient and foolproof temperature control.

Questions

FROM HOME OWNERS

Q.—I AM planning to cut out some wooden house numbers to put up on my front porch. Is there an easy way to treat the numbers so that they will shine in the dark?—T.L.P., Charleston, W.Va.

A.—Cut out paper, paste it over the front of the numbers, and then coat it with waterproof glue. Before the glue dries, sift on a layer of luminous calcium sulphide, which is available from most dealers in chemical supplies. Luminous paints also may be used, but they should be adequately protected from rain to maintain their efficiency. It might be well to cover the treated numbers with thin sheets of glass before putting them in place.

Easy Way to Wax Linoleum

B.E.R., WALLA WALLA, WASH. Floor linoleum will last longer if it is given a thorough waxing. Splash on a quantity of very hot water to heat the linoleum and then rub in the wax while the surface is warm. Additional wax should be applied each time the linoleum is washed.

Leave the Hornets Alone

C.B.B., BIRMINGHAM, ALA. There is no reason for removing a hornet's nest from the eaves of a house unless the insects actually are a nuisance. Hornets are very useful in destroying insect pests that attack garden plants and flowers.

Filler for Wall Cracks

Q.—I HAVE tried to repair some thin cracks in the concrete wall of my cellar with ordinary cement, but find that it tends to pull away (*Continued on page 17*)

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QUESTIONS FROM HOME OWNERS

(Continued from page 16)

and drop out. Can you suggest another type of filler?—D.D.M., Denver, Col.

A.—SOAK an ounce of glue in three quarts of warm water. When the glue has dissolved, add a pound of flour, one tablespoonful of borax, and one tablespoonful of alum. Stir shredded newspapers into this solution to form a puttylike mass and then ram it into the cracks with a hammer and a blunt cold chisel.

Hardened Rubber Is Hopeless

Q.—CAN you recommend anything that will soften a rubber cushion that has hardened with age?—M.B., Rochester, N. Y.

A.—RUBBER that has become hardened with age cannot be softened or restored to its original condition, since long contact with the air has changed its nature by a process of oxidation.

Preserving Clothesline Pole

J.S., BURLINGTON, VT. Creosote, properly applied, will prevent the base of a wooden clothesline pole from rotting below ground level. Bore a small, slanting hole in the post just above the ground and fill the cavity with creosote. Stop the hole with a plug and apply more creosote after about three or four days. After a week, pour in a third supply and then fasten the plug permanently in place.

How to Clean Piano Keys

Q.—WHAT is a good way to whiten piano keys that have turned yellow?—H.H., Little Rock, Ark.

A.—WIPE the keys with gasoline, dry thoroughly, and then rub them vigorously with a rag which has been dipped in a three-percent solution of hydrogen peroxide. After the bleaching process has been completed, rinse the keys with clean water and rub dry with a soft cloth.

Talc Cures Floor Squeak

Q.—THERE is one board in our living-room floor that persists in squeaking although I have tried to silence it dry driving finishing nails into the ends. Have you any other suggestions that I can try?—J.L., New York, N. Y.

A.—ALTHOUGH a board that squeaks generally is loose and should be silenced when properly nailed, chronic squeakers sometimes can be cured by sprinkling a little talc (magnesium silicate) or talcum powder along the crack and working it in between the boards. If both nailing and the powder treatment fail, the trouble probably is caused by loose under-flooring.

Insulating Cement for Asbestos

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New COPYCRAFT Whittling Kit

OUR new copycraft whittling kit for making Hobo Hank is proving extremely popular with those who have always wanted to learn how to whittle but in the past have found difficulty in following drawings. As explained recently (see P.S.M., Jan. '37, p. 71), the kit contains a perfect reproduction of the figure, made of tough molded composition and looking exactly like wood. The model reveals every knife cut so that it is easy to carve a duplicate from the wood supplied with the kit.

An extra block is included for making a useful stand for Hobo Hank, to be used as a desk set, pipe rack, ash tray, book end, or something similar. In the kit also are three bottles of paint, a brush, and a sharpening stone. It is listed as Kit No. 10 and costs only \$1.50.

The number of readers finding enjoyment with our kits grows daily because we now have kits for every type of amateur craftsmen—simple kits for the beginner and elaborate projects for those more advanced. In every case, all the essential materials, as well as the necessary drawings and instructions, are included.

Besides the Hobo Hank kit, there are three other whittling kits, two furniture kits, and a wide variety of ship model kits. The list follows:

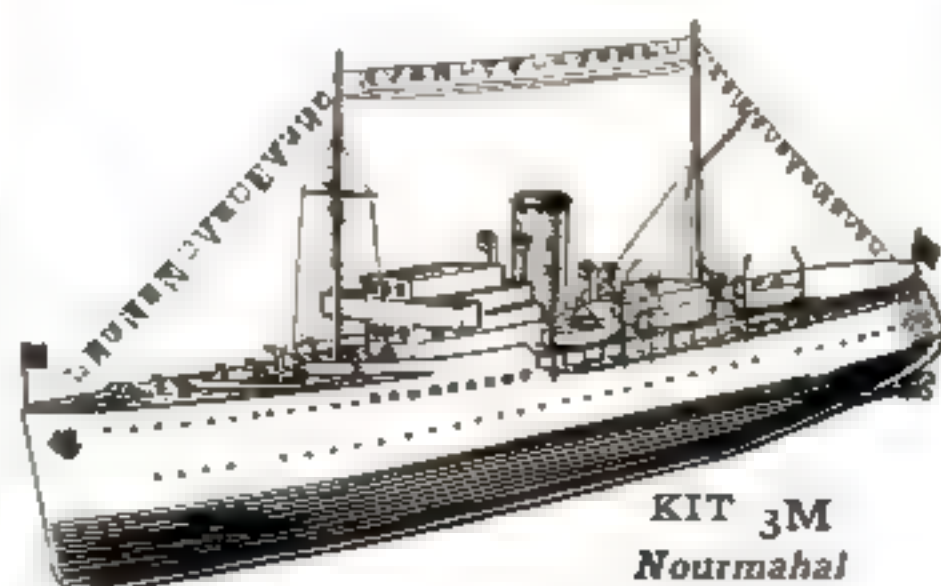
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(Continued on page 19)



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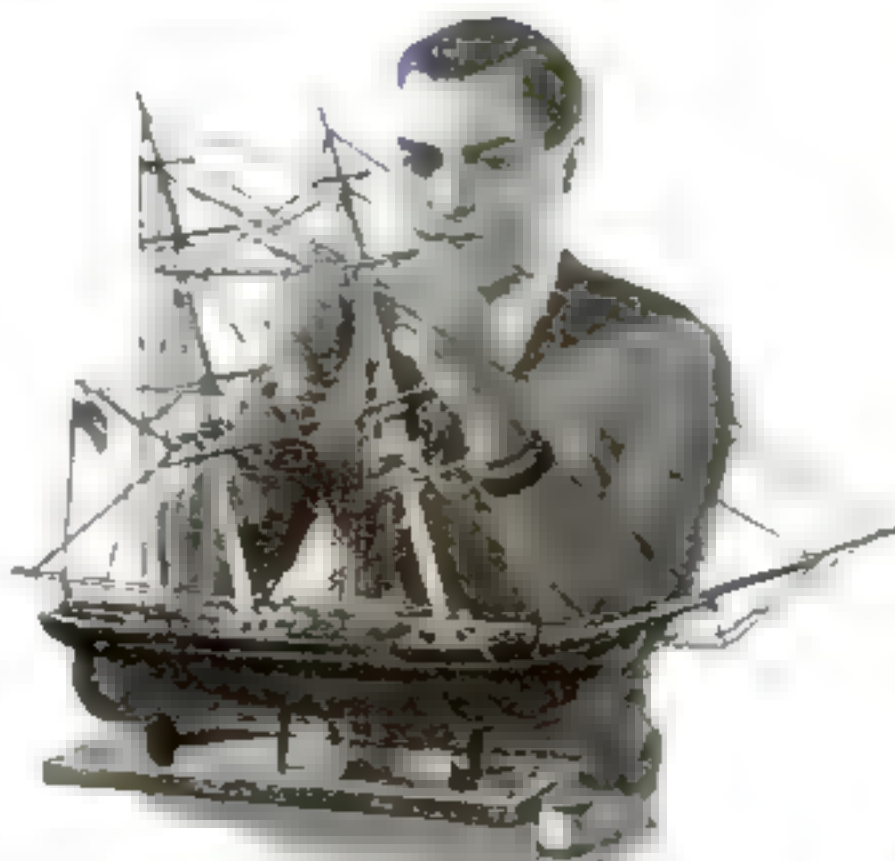
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OUR CONSTRUCTION KITS

(Continued from page 18)



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- Y. Trading schooner, 17 1/2-in. hull..... 4.90†
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- 5S. Coast Guard patrol boat of new 165-ft. class. Full-hull model, 1/4-in. scale, the hull being 20 1/2 in. long..... 4.95*



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- 7S. Brig Malek Adhel, as above, but with sawed-out lifts for solid hull construction 9.75*

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- N. Four U.S. destroyers, each 6 1/4-in. .75
- O. Liner S.S. St. Louis, 11-in..... 1.00
- R. U. S. cruiser Tuscaloosa, 11 1/4-in... 1.00

(Continued on page 20)



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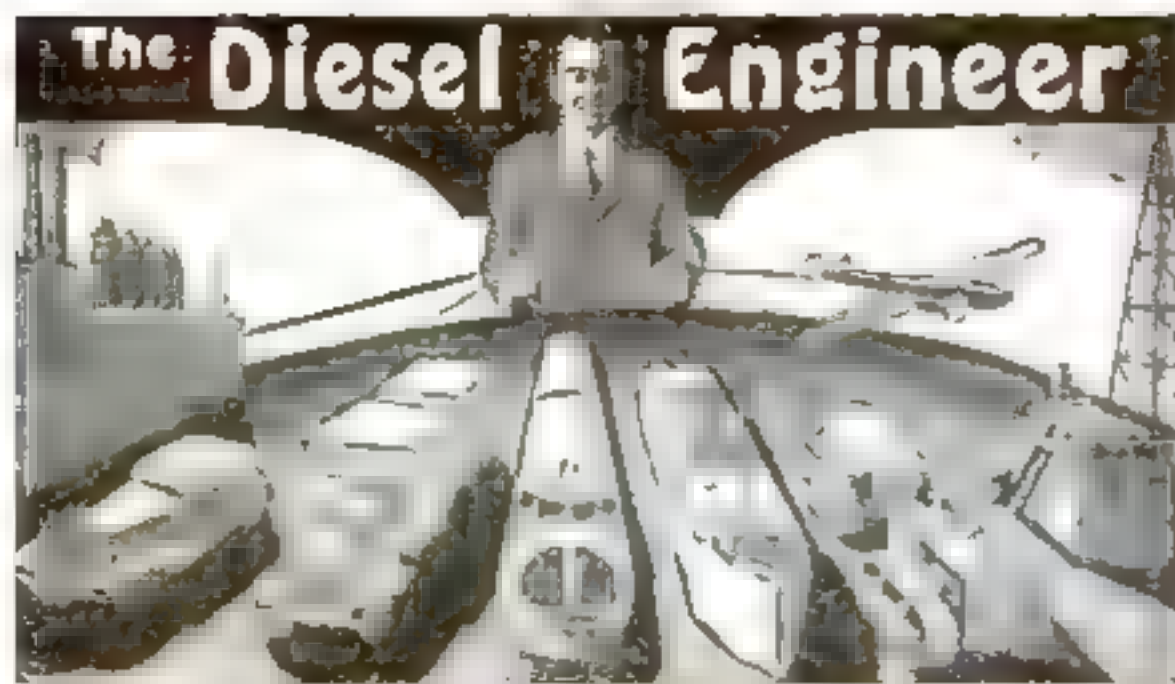
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OUR CONSTRUCTION KITS

(Continued from page 19)



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NEW RANGE FINDER USES TELEVISION "EYES"

TELEVISION replaces the human eye in a range finder invented by three Americans, two of them U. S. Army men, for directing the fire of big coast defense guns against enemy warships. Spaced a fixed distance apart, a pair of television cameras are simultaneously trained by an observer upon the target, until twin images seen upon a viewing screen coincide. A glance at a chart then gives the correct setting for the guns.

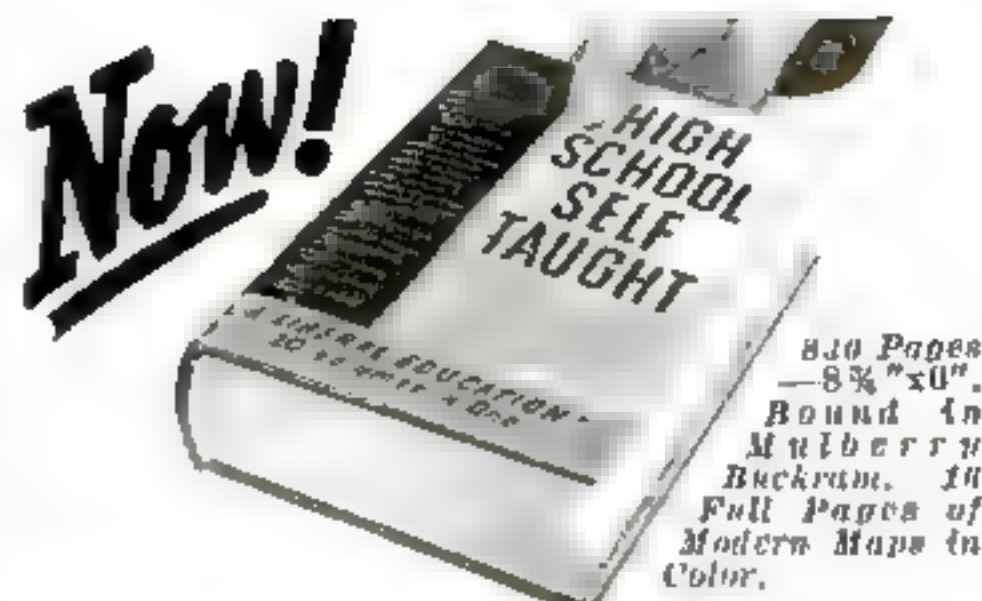
Whether similar equipment was used when Signal Corps men successfully used a "mystery ray" device to locate a ship cruising under cover of darkness off the New Jersey coast (P. S. M., Oct., '35, p. 29) has not been disclosed. A fact that may lend important military significance to the new range finder however, is that television apparatus has been perfected to a point where images can be produced of objects hidden from the eye by fog or darkness, using invisible rays such as those emitted by the heated funnels of warships and the motors of airplanes.

SEEKS ALTITUDE RECORD WITH TINY BALLOONS

THOUSANDS of tiny balloons, tied together, may carry future aerial explorers to record heights. To test the feasibility of the idea, Prof. Jean Piccard of the University of Minnesota first plans to hitch together eighty balloons of the four-foot, hydrogen-filled type used for carrying automatic weather instruments aloft, and to attempt an ascension to an altitude of 10,000 feet in an open basket. Since each balloon has an individual lifting power of five pounds, the "balloon team" will have a total of 400 pounds lift as it leaves the ground. If the flight turns out successfully, Prof. Piccard then plans to attach several thousand of the balloons to a sealed gondola and try to reach a height of from seventeen to twenty miles above the earth. When he wants to come down, he will cut loose as many of the small balloons as necessary. This will be accomplished from within the gondola, by touching off miniature blasting caps attached to the restraining cords.

PLAN PASSENGER PLANES TO FLY SIX MILES UP

PASSENGERS will speed along air lanes nearly six miles above the earth, in airplanes for which plans have just been revealed by a leading American firm of builders. Within hermetically sealed cabins, air-conditioning apparatus will maintain an artificial atmosphere simulating conditions at ground level. Thus the passengers will be assured sufficient oxygen to breathe, and will be shielded from the discomfort of lowered air pressure in the rarefied atmosphere of the 30,000-foot substratosphere level. Experimental sealed-cabin planes for high-altitude flight already have been tried out here and abroad, but the proposed craft are the first designed for commercial use. They are expected to be completed and placed in service within about eighteen months.



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TESTS THROW NEW LIGHT ON CARBON MONOXIDE

IF THERE is only one part of carbon monoxide gas in 1,000 parts air, the mixture is sufficiently deadly to render a healthy man unconscious in half an hour. This is but one of the discoveries made in tests at the Fatigue Laboratory, at Harvard University, Cambridge, Mass.

Other experiments with this deadly gas, which is present in the fumes of motor cars, revealed that a person collapses, without warning, when his blood is one-third saturated with the gas. If a person is exercising, he succumbs more quickly than if he is sitting still.

To study the effect of this deadly gas, six men at the University, two students and four research scientists, offered themselves as "human guinea pigs," and made tests in gas chambers. In one experiment, Dr. W. H. Forbes, of the Fatigue Laboratory, collapsed after he had submitted to a series of tests, and his blood was found to be almost half saturated with carbon monoxide.

A related survey on the highways revealed that about five percent of the closed trucks and automobiles have dangerous accumulations of carbon monoxide gas from the motors.

At regular intervals, during the laboratory tests, the subjects in rooms containing varying concentrations of the gas, were tested for perception, reaction time, judgment, and other qualities needed in automobile driving. Blood samples also were drawn at intervals to ascertain the percentage of saturation with the gas. A strange fact that was proved by the tests is that there is no decrease in skill even when the subject is on the verge of collapse. He feels no ill effects, no drowsiness. He faints without warning and, unless he can be revived in fresh air, he is doomed.

SUN SPOTS BLAMED FOR RECENT FLOODS

DID sun spots cause the disastrous floods of recent months? One Rochester, N.Y., scientist recently advanced the theory that these disturbances, 93,000,000 miles out in space, were responsible for the warm weather which brought rain instead of snow and produced the flood waters in the Ohio and Mississippi. One of the sun spots which astronomers have been studying is said to be at least 30,000 miles across at the present time. Half a dozen planets the size of the Earth could be dropped into this area, which represents but one of a number of similar spots.

LIGHTWEIGHT WIRE CUTS RURAL CURRENT COST

TO BRING electricity to farms at lower cost, engineers of a Detroit, Mich., utility firm have invented an economical new type of rural transmission line. Consisting of aluminum with a steel core, the wire is so light and strong that poles supporting it may be spaced 400 feet apart, instead of 200 feet as heretofore, and savings in the cost of poles and of their erection can be passed along to the consumer.



The Unholy Search!

DID NATURE REVEAL HER SECRET?

MEDDLERS in God's affairs. Triflers with sacred things, they were said to be. In musty garrets, in the eerie hours of the night, they bent low over iron crucibles and their strange smelling contents. By what right did they match human intelligence with the forces of the universe, and seek to know their mysterious workings? They were not demons or black magicians, as the superstitious masses of the Middle Ages thought them, but wise men—alchemists—who disclosed nature's greatest secrets at a time when the world was in ignorance. They discovered a method to arouse man's inner powers. MASTERY, DOMINANCE, SUCCESS are secret functions of the mind, they learned. Every man and woman, it was found, can attain personal mastery in life, when shown how, for the elements are hidden within them.

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DEVICE GAUGES SHOCKS FROM "BUMPS" IN AIR

AFTER more than 20,000 hours in the air; an ingenious "bump-recording" device has given scientists of the National Advisory Committee on Aeronautics at Langley Field, Va., valuable data on the strains produced in airplanes during gusty weather. The automatic mechanism, which is formed by a combination of levers that actuate a stylus rubbing on smoked glass, was designed by Research Engineer Richard V. Rhode. It was used in flights over both land and water, totaling more than 3,000,000 miles. The results indicate that the "bumps" of a fairly smooth flight rarely increase the load of a plane more than half the pull of gravity. But when the craft is plunging at three miles a minute through a squall, the sudden additional strains on the machine may rise to three or more times the pull of gravity. The importance of this information is that it indicates just how strong a plane must be built to be safe in bad weather. Comparison between the recordings made over land and over sea showed that above-water flying usually is smoother.

WEATHER DATA SOUGHT BY POLAR EXPEDITION

To study the effects of masses of polar air on the weather of the eastern section of the United States, C. J. McGregor, U. S. Weather Bureau meteorologist, is planning to lead a scientific expedition into the arctic regions, starting about the middle of June. Carrying a six-place observation plane and complete radio equipment, the expedition will embark on an iron-plated schooner for its projected base at Fort Conger, on the northern tip of Ellsmere Island, about 600 miles south of the north pole. In addition to observations made on the surface, balloons equipped with robot radio transmitters will be released to report meteorological data at high altitudes. Weather reports will be radioed to the United States twice daily during the course of the expedition's two-year stay. An attempt will also be made to take the first color movies of the aurora borealis, it is reported. Two families of Eskimo hunters will be picked up in Greenland to supplement the main party of about fifteen scientists and technicians now scheduled for the trip.

FIND TINY SHELLFISH GNAW SHIPS' CABLES

A MARINE PEST called a gribble, or sometimes a "seagoing wood louse," has been found to be responsible for destroying mooring cables and other ropes used in harbors along the New England coast. Experiments made by scientists at North Plymouth, Mass., showed that this tiny crustacean, resembling the familiar "pill bug" found under old boards, has developed a taste for Manila rope. Previously it was known to be destructive to wood pilings, lobster pots, and mooring buoys. In two or three months, it was found, such pests could cut through the fibers of a large rope if it were not protected with a coating of metallic paint.

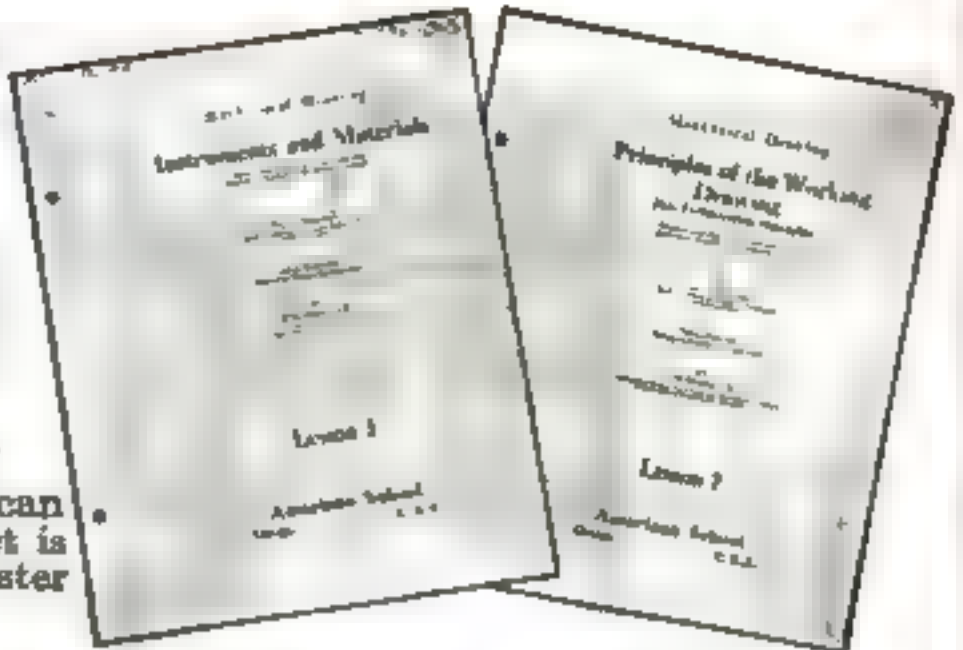
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ONE of the world's rarest minerals, Hackmanite, has recently demonstrated what appears to be a new property of matter. This mineral was first discovered in the fiords of Greenland more than a century ago. Later, other specimens were found in the crater of the volcano Vesuvius in Italy. It has a deep blue color, and has been prized for years as a collector's piece for scientific museums.

Recently, the American mineralogist, O. Ivan Lee, of Jersey City, N. J., made the surprising discovery that a red-violet streaking on the face of a piece of Hackmanite can be revived at will by subjecting the mineral to ultra-violet rays. It has been observed in the past that when a piece of the mineral was broken, beautiful red-violet splashes of color appeared on the clean surface of the fracture. On exposure to ordinary light, however, they faded away. Radiation with ultra-violet light, the New Jersey mineralogist has shown, will bring back this lost property and the experiment can be repeated as many times as is desired.

So far, science is at a loss to explain the phenomenon. The first theory advanced was that fluorescence explained the appearance of the color. Tests, however, have revealed that the mystery is not produced by either fluorescence or phosphorescence. Lee calls the phenomenon "reversible photosensitivity" and suggests that it is a new property of matter hitherto unknown to mineralogy.

Strangely enough, Hackmanite has been found almost entirely in wild and unusual places. Besides the Greenland and Vesuvius regions, other scenes where the rare mineral has been picked up are on the Kola Peninsula in Arctic Russia and near Bancroft, in the province of Ontario, Canada.

SUITCASE BALLOONS, small, fifty-pound gas bags capable of being folded up and packed in an ordinary valise when they are deflated, have been designed by A. Leo Stevens, a pioneer American aeronaut. Made of light silk, the balloons are designed for the use of amateurs. Stevens, who made balloon flights before 1890 and who went aloft in one of the first dirigibles built in the United States, believes such single-passenger bags might be used by commuters. When the wind is blowing from the right direction, he points out, they could take off from skyscrapers in large cities and ride without noise, dust, or traffic congestion to the suburban communities in which they live.

EARTHWORMS that live in trees have been discovered in northern Siam. H. G. Deignan, a collector for the Smithsonian Institution, in Washington, D. C., reported the finding of the curious worm, which as yet has not been identified, while on an expedition which brought back a collection of more than 600 birds native to Siam.

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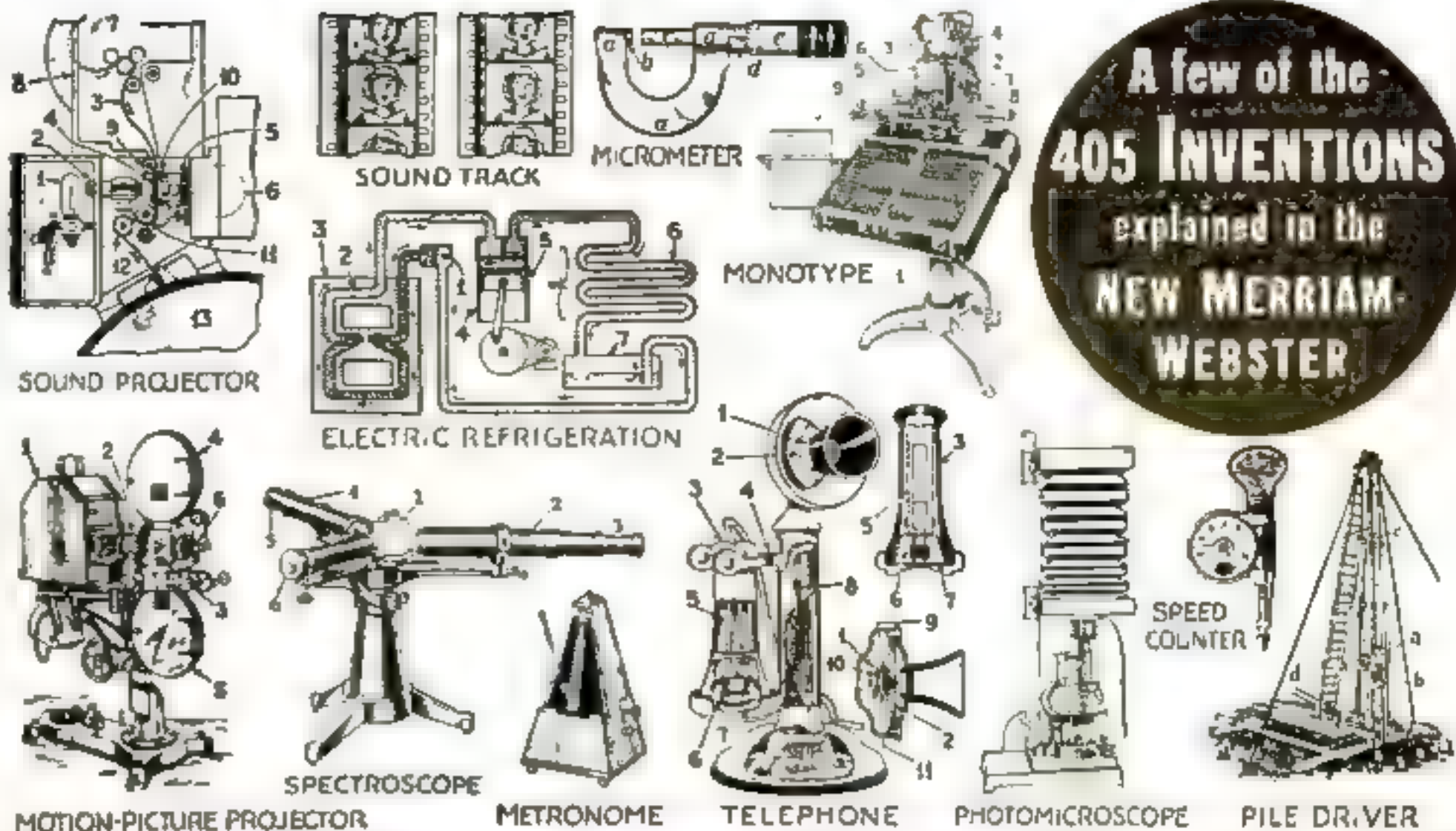
Using dry ice to supply power for squirting water on forest fires is an innovation recently announced by Acting Superintendent A. B. Everts of the Cleveland National Forest in southern California. This frozen carbon dioxide changes directly from solid to gas without melting into liquid. One cubic inch of the solid makes 450 cubic inches of gas when it is free to expand at atmospheric pressure. In confinement, the gaseous carbon dioxide reaches a pressure of as much as 1,000 pounds to the square inch. In the new apparatus, the pressure is reduced by control valves to 250 pounds to the square inch before being used to drive water through the hose. The complete power unit, replacing cumbersome gasoline engines, is formed of two small tanks each holding twenty-five pounds of dry ice. It is attached to a fifty-gallon water tank which can be emptied several times by the pressure of the one filling of frozen carbon dioxide. By reducing the size and weight of the fire-fighting equipment necessary, the new method is expected to save precious time in getting work under way when a blaze is sighted.

AUTOMATIC PLANE LOG KEEPS FLIGHT RECORD

THREE automatic pens, leaving indelible trails on a rotating drum, will write the story of every transport passenger flight made in the United States, through a new ruling of the U. S. Department of Commerce. The instrument, to be installed in airliners, was designed by experts in a laboratory in Baltimore, Md. One pen will trace the altitude of the plane from the take-off to the landing. A second will show the number of times the pilot communicates with the ground by his two-way radio, giving the exact time of each call. The third will give the record of the radio-beacon receiver, and if it fails to function will show just when it goes out of order. Such an installation, Government officials believe, would be a help to attaining greater safety on the airways. The cards on which the records will be made, according to present plans, will be in the form of route or contour maps so the tracings can be compared with the actual course followed by the plane.

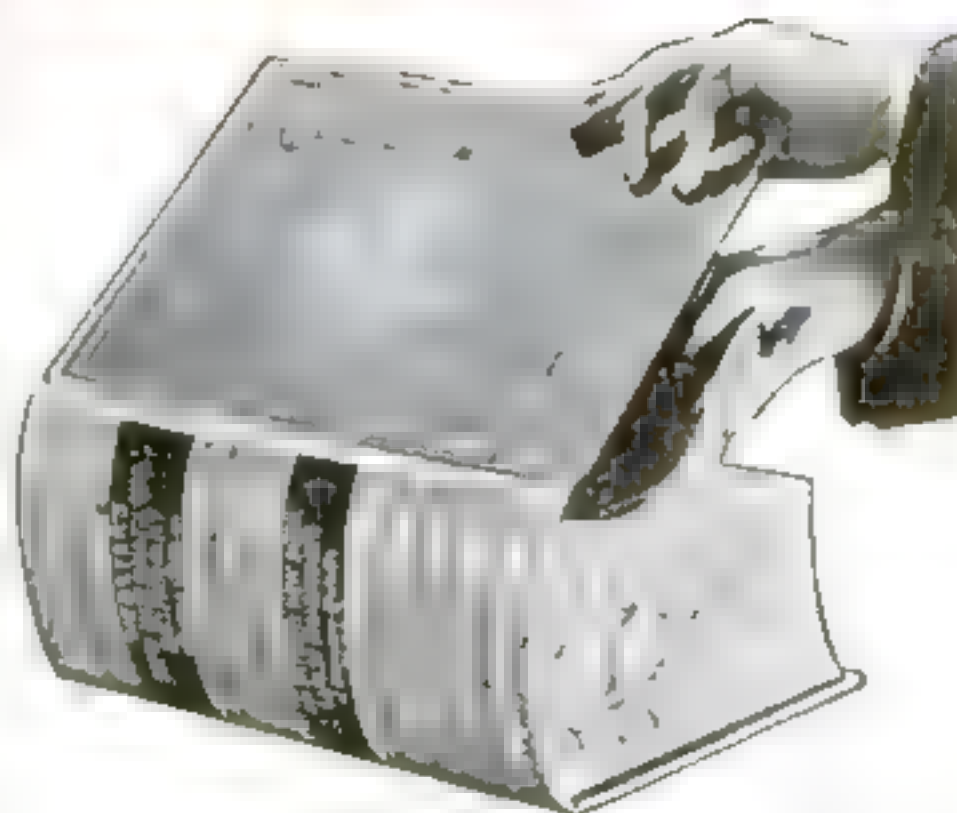
LATEST STUDIES REVEAL HOW MOLECULES LOOK

WHAT do molecules, the building blocks of all material things, look like? Some are spherical like tennis balls, while others are elongated like footballs, latest researches indicate. Among the latter are the protein molecules of which human muscles are made. Microscopes fail to reveal even these giants of the molecular world, from 1,000 to 5,000 times as long as particles of other materials. They have been studied, however, by separating them from foreign substances with the aid of a whirling device called an ultracentrifuge and observing the way that they pass through filters and animal membranes.



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TEMPERATURE—3000 degrees!

...but FORD GASKETS

are built to take it

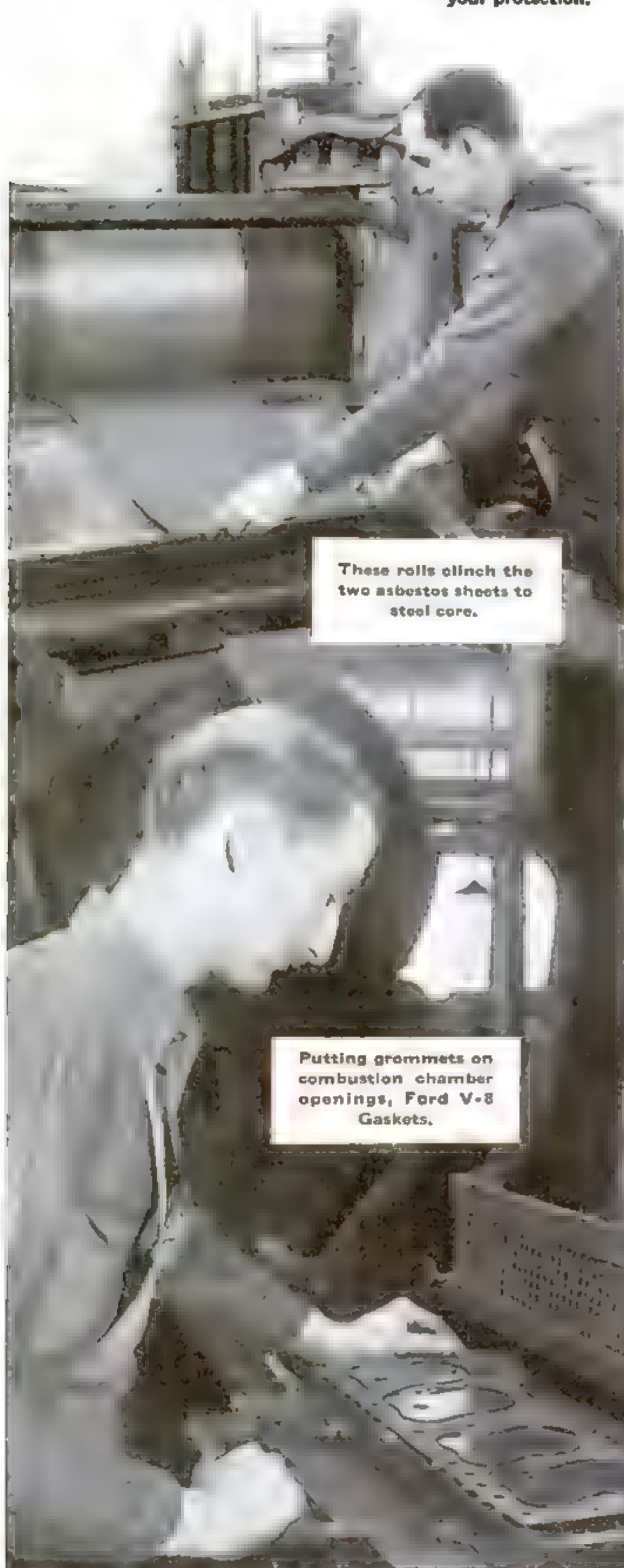
Each explosion inside a Ford V-8 combustion chamber may exert a pressure of as much as 600 pounds per square inch. The flames from the burning gases reach temperatures as high as 3000 degrees. At such temperatures and pressures, a lot depends upon gaskets. They must keep these hot gases from leaking into the water jackets. They must keep the jacket water from entering the combustion chambers. They must provide as effective a seal between head and block as the metal of these parts themselves.

Genuine Ford Cylinder Head Gaskets are built to give long, dependable service under these severe conditions. A steel core is permanently bonded between two thicknesses of specially treated asbestos that resists the effects of water, gasoline and oil. Combustion chamber openings are reinforced with a steel edging for protection against blowing out. And correct compression in the cylinder heads is assured because Genuine Ford V-8 Cylinder Head Gaskets compress to the correct thickness (.048 to .051 inch).

As with all Genuine Ford Parts, Ford Gaskets are made of the highest quality materials, by experienced workmen, and according to Ford standards of precision. To maintain the high quality that was built into your Ford V-8 at the factory, insist upon Genuine Ford Parts when replacements are needed.

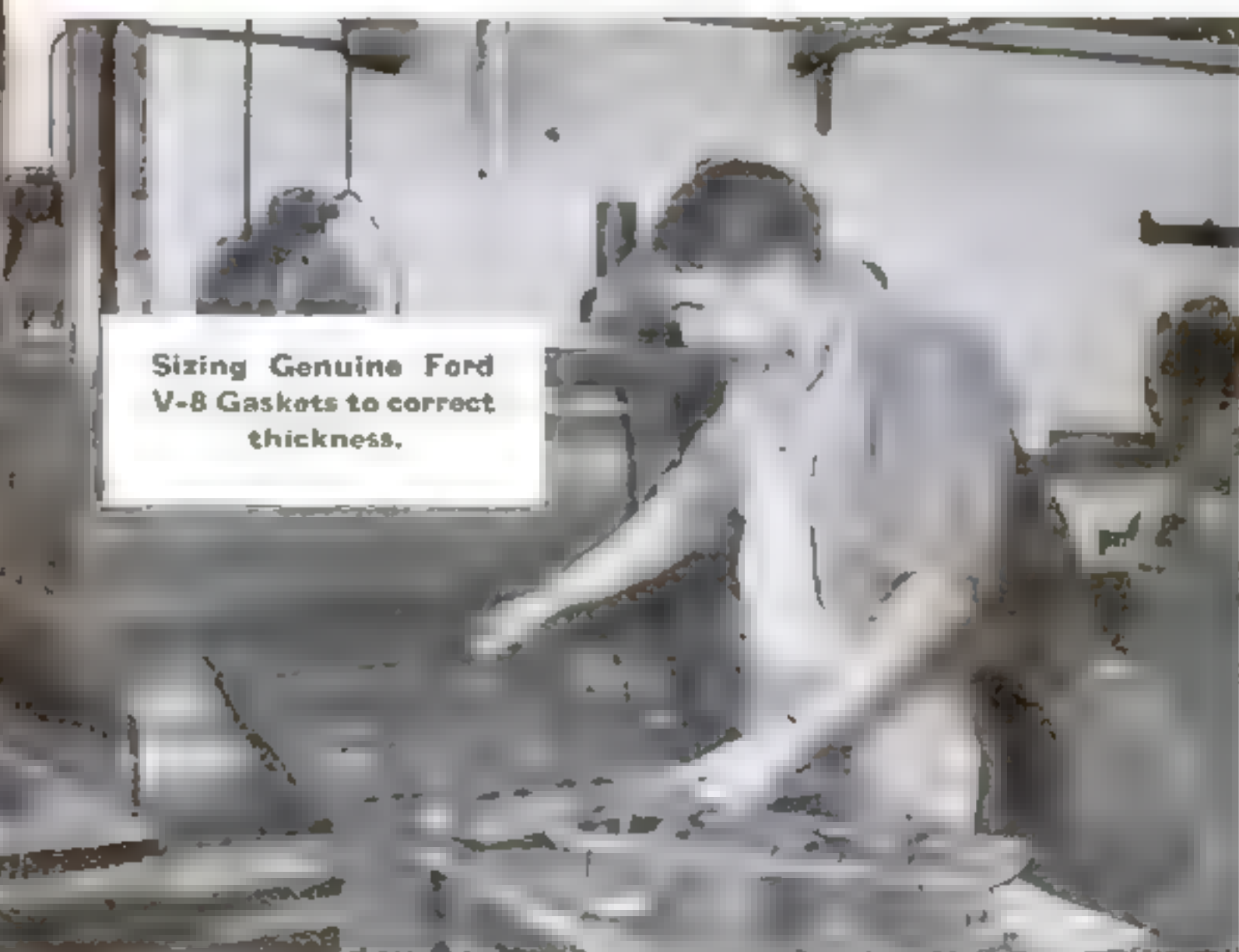


FORD MOTOR COMPANY, DEARBORN, MICHIGAN



These rolls clinch the two asbestos sheets to steel core.

Putting grommets on combustion chamber openings, Ford V-8 Gaskets.



Sizing Genuine Ford V-8 Gaskets to correct thickness.

Giant X-Ray Machines



SCIENCE'S SIEGE GUNS
IN WAR ON DISEASE

By John E. Lodge

A FEW DAYS ago, Dr. Francis Carter Wood, Director of the Crocker Institute for Cancer Research, led a group of scientists into a basement room at the Presbyterian Hospital, in New York City. There he demonstrated a new 18,000-pound machine which, at the flip of a switch, will send 1,200,000-volt X rays streaming from five openings in a lead-sheathed tank.

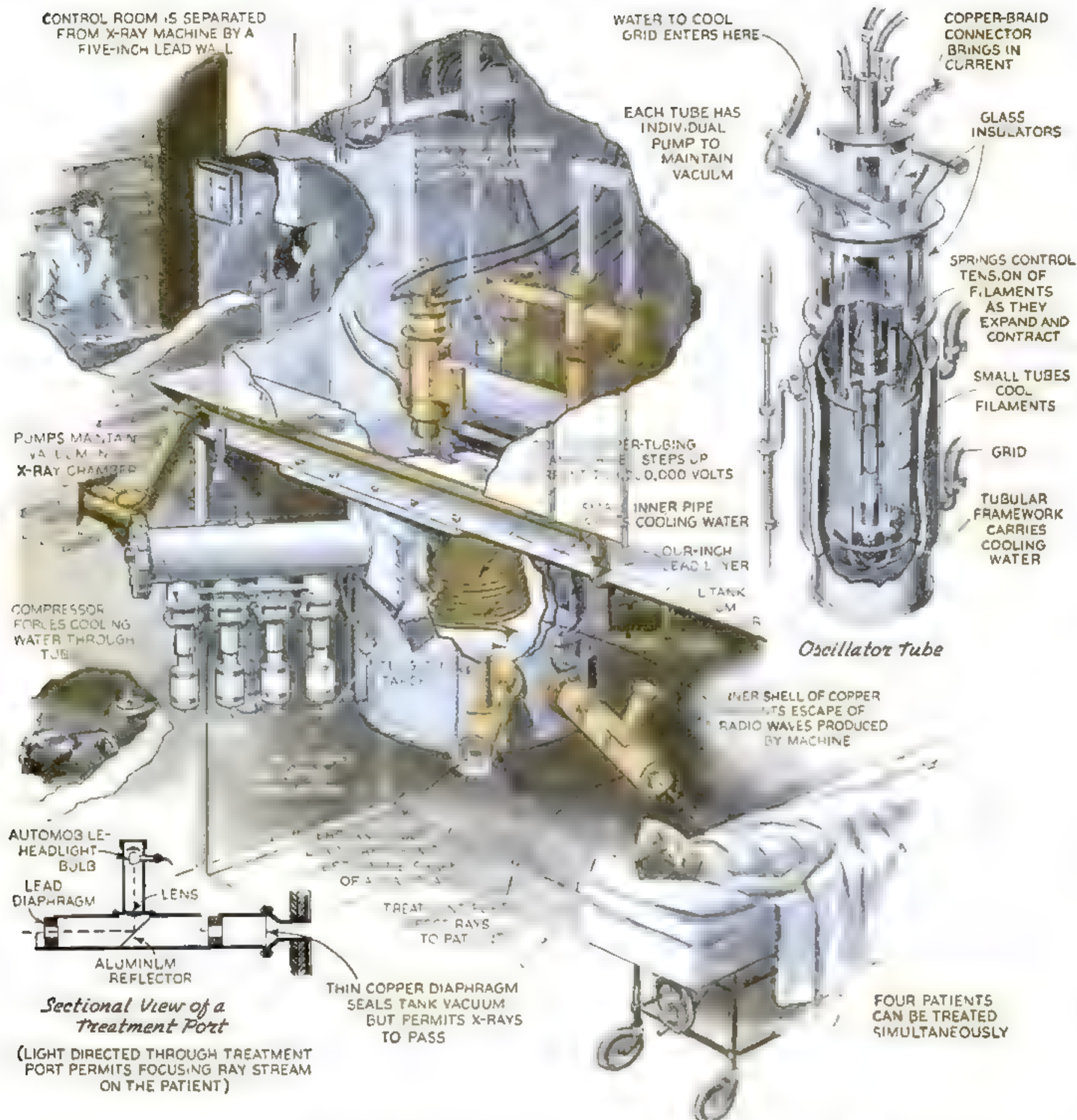
At this writing, news flashes from Boston, Mass., from St. Paul, Minn., from San Francisco, Calif., and from London, England, all tell of similar giants either under construction or in actual use. Like mammoth siege guns in a war on disease, these 1,000,000-volt machines are going into action in various parts of the world. The story of the X ray has entered a new and dramatic chapter.

What will its pages record? What will these giants of the laboratory achieve? All science is vastly interested in knowing the answers to those questions.

One of the first tests planned at the Presbyterian Hospital, in addition to cancer research, is a study of the effect of high-voltage radiation on viruses. These mysterious protein molecules are known to reproduce themselves in the presence of living tissues. They are thought to cause many diseases, including common colds. But they are so small that they neither can be seen through a microscope nor strained out with a porcelain filter. Radiation of relatively small voltage has little if any effect upon them. Now, however, scientists can treat the mystery molecules with super-rays from 1,000,000-volt machines.



A MILLION VOLTS ON TAP. The mammoth electrostatic generator used in X-ray work at the Huntington Memorial Hospital in Boston, Mass. At top of page, experts adjusting the new giant X-ray machine at the Presbyterian Hospital, New York City



This drawing gives details of the Presbyterian Hospital's new 1,200,000-volt X-ray unit. It is to be used for cancer research

To make such rays possible, inventors have turned to radically new designs and have created a host of innovations. In the case of the New York machine, 15,000-volt current is passed through radiotype tubes as tall as a child and on into a copper-tube transformer coiled like a giant bed spring within its vacuum container. Swift streams of ice-cold water rush through smaller pipes within the coil to keep the larger tubes from melting.

Unlike the ordinary X-ray apparatus you see in a dentist's office, the machine has a vacuum chamber of steel, lead, and copper. Small X-ray outfits use glass vacuum tubes within which electrons from a cathode, or negatively charged electrode, strike a target of tungsten. Just as the energy of a bullet turns to heat when it strikes a stone wall, so the elec-

trons produce X rays when they hit the target. These rays shoot off in all directions, but lead shields keep them from escaping except through openings left for the purpose.

Inclosing the metal vacuum chamber of the Presbyterian Hospital's machine is a sheath of lead four inches thick. Four feet high and four feet in diameter, this chamber resembles a water tank with oversize spouts sticking out at various angles. These are the "treatment ports" through which the X rays are directed. An ingenious feature is the use of lead disks, fitting in the ends of the tubes to cut off rays which do not strike the exact area of the patient's body requiring treatment. Light, reflected from within the tubes, enables the operator to focus the ray stream even before it is turned on.

A young scientist at the University of California, David H. Sloan, originated the idea for the big machine. Nearly two years have been required by Frank M. Exner, physicist of the Crocker Institute, New York City, and his associates to complete the installation. As is the case with all the 1,000,000-volt machines, it is intended primarily for cancer work.

Four patients at a time can be treated when the apparatus is in operation. The same number can receive simultaneous treatment from another huge X-ray unit, just installed at the Miller Hospital, in St. Paul, Minn. This \$75,000 machine rears thirty-five feet into the air, and within its twenty-seven-foot vacuum tube the electron stream bombards a target of gold.

The five-inch disk of precious metal is

cooled by oil which, in turn, is kept at lowered temperatures by water. Gold is used for the target because of its superior ability to withstand the bombardment of the electrons. Two other features of this installation are a periscope which enables the physician to observe patients from behind a thick barricade of concrete and lead, and a two-way loudspeaker system which keeps doctor and patient in constant touch throughout the treatment.

Safeguarding both the patient and the operator is a prime consideration in the design of the super-ray machines. At St. Bartholomew's Hospital, in London, where the only 1,000,000-volt apparatus in Europe is being put into operation, electrical controls automatically cut off the rays if anyone opens the treatment-room door by accident.

Twin generators, each with a capacity of 600,000 volts, will feed current into the ten-ton, thirty-foot steel cylinder which forms the vacuum tube of this English giant. The most novel feature of the design, however, is an immense cylinder of steel, lined with closely-packed shot, which encloses the vacuum tube.

Both cylinders turn on the same axis, but they can be rotated independently of each other. Thus, the operator can, at will, direct the rays through an opening toward a patient or upward into a six-inch saddle of lead which cuts them off completely. Without shutting down the machine, he can turn the rays on and off so far as

effectiveness in treatment is concerned.

A few months ago, the noted American radiologist, Dr. G. Failla, announced a safety device for use with X rays of 1,000,000 volts or more. It is ingeniously simple, consisting chiefly of an aluminum cone open at both ends like a megaphone.

When the stream of rays is directed down through the small end, secondary electrons, which ordinarily curve outward on a tangent, strike the metal and are prevented from reaching the skin of either patient or operator and causing trouble.

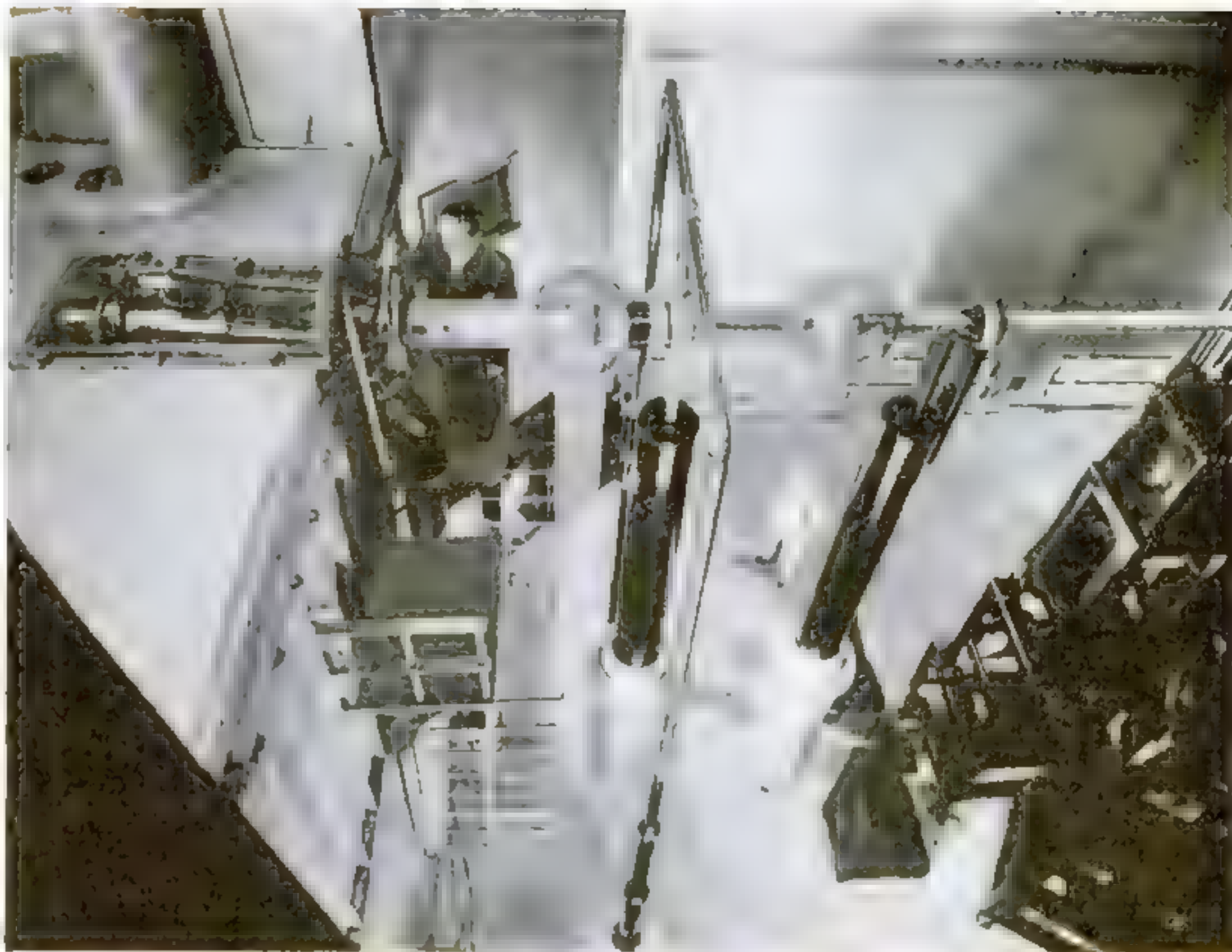
Six paper belts, spinning at high speed, will build up the reserves of current used in the most unusual of the super-ray machines, one nearing completion in Boston, Mass. The design is

based upon the electrostatic generator which was originated a few years ago by a young Princeton University scientist, Robert J. Van de Graff. (P.S.M. Jan. 1932, p. 19.) The whirling belts brush against an immense metal doughnut, depositing charges of negative electricity and carrying away positive charges to a grounded terminal below.

From the doughnut-shaped terminal above, a stream of electrons will shoot downward through a gigantic vacuum tube projecting through the floor into a treatment room below. Striking a water-cooled gold target, it will send off high-voltage rays able to reach and treat cancers in any part of the body. Two Boston scientists, Dr. John G. Trump, of the Massachusetts Institute of Technology, and Dr. Richard Dresser, of the Huntington Memorial Hospital, worked out the design for the new machine.

The coming of 1,000,000-volt X rays is, of course, the most spectacular news in the world of radiology. But other advances in laboratories, in factories, on farms and in hospitals tell a story of progress on many fronts. The X ray is daily taking on new tasks and demonstrating new abilities.

A few months ago, for example, a group of Wisconsin chemists reported the completion of an "X-ray fingerprint" file which will enable them to cut the time of analyzing unknown crystalline chemicals from hours to minutes. This file contains more than 4,000 negatives, each of a different compound. By measuring in from the left edge of the film to lines of varying density in the pattern, the chemists obtain a clue to the identity of an unknown compound. Reference to a standard classification catalogue, which they have assembled, gives the final check. Their method is applicable only to compounds in (Continued on page 119)



An unusual view of a large X-ray tube and machine in Chicago, Ill. The patient to be treated is wheeled into the lead-lined chamber at the left, and placed so that the rays will strike the diseased part



At the left is an ordinary X-ray picture of a lung, with shadows caused by ribs. Shadows are eliminated in the picture above, made with the swinging "tomograph" seen in circle

Novel Sound System

BRINGS NEW REALISM TO THE THEATER

By Grover C. Mueller

MAGIC wrought with twenty-eight huge loudspeakers aids a cast of 300 players to dramatize the Biblical story of the Jewish people, in New York's theatrical sensation, "The Eternal Road." The unprecedented sound installation is a part of an electrical wonderland, behind the scenes of the remodeled Manhattan Opera House, that heralds the marvels of the theater of the future.

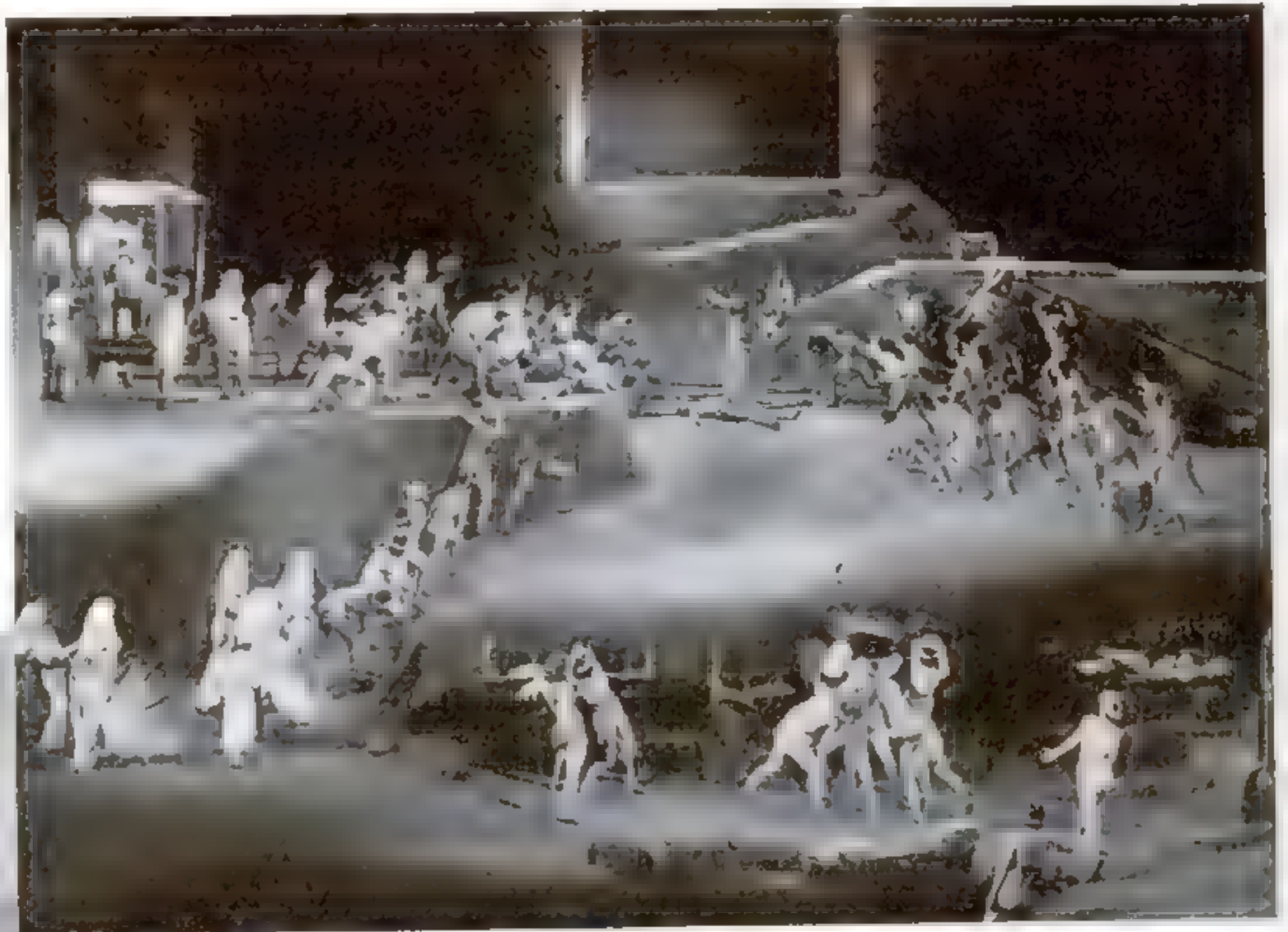
Instead of occupying a pit at the front of the stage, the orchestra and an electric organ play offstage in a soundproof booth resembling a radio broadcasting studio, and a microphone picks up their music. By pressing buttons of an ingenious remote-control system, the orchestra leader can start sound-film reproducers in a separate chamber. A microphone at another backstage location picks up the sound of wind machines and other standard theatrical effects. A "sound mixer" twirls dials on a control panel to blend all these sounds. The audience hears the final result from the system of

hidden loudspeakers. Thus, fifteen or so singers on the stage can give the illusion of thousands singing, with the simultaneous accompaniment of the orchestra, electric organ, mechanical sound effects, a sound-film recording of a sixty-piece symphony orchestra, and another sound film of mass choral effects.

Through an independent "whispering system" of more than two dozen small loudspeakers installed at key points backstage, two prompters direct the perform-

ance with a running fire of instructions to the cast, the scene shifters, and the operators of sound and lighting effects. Electric current required for the lights and sound apparatus reaches the staggering total of 3,000,000 watts, enough to light all the homes of a small city. A forty-foot-long strip of the city street outside the theater had to be dug up to a depth of fifteen feet to install the transformers that handle this torrent of electric power. During the performance, it is controlled from a basement switch-board room, a maze of levers and cables suggesting a train dispatcher's tower.

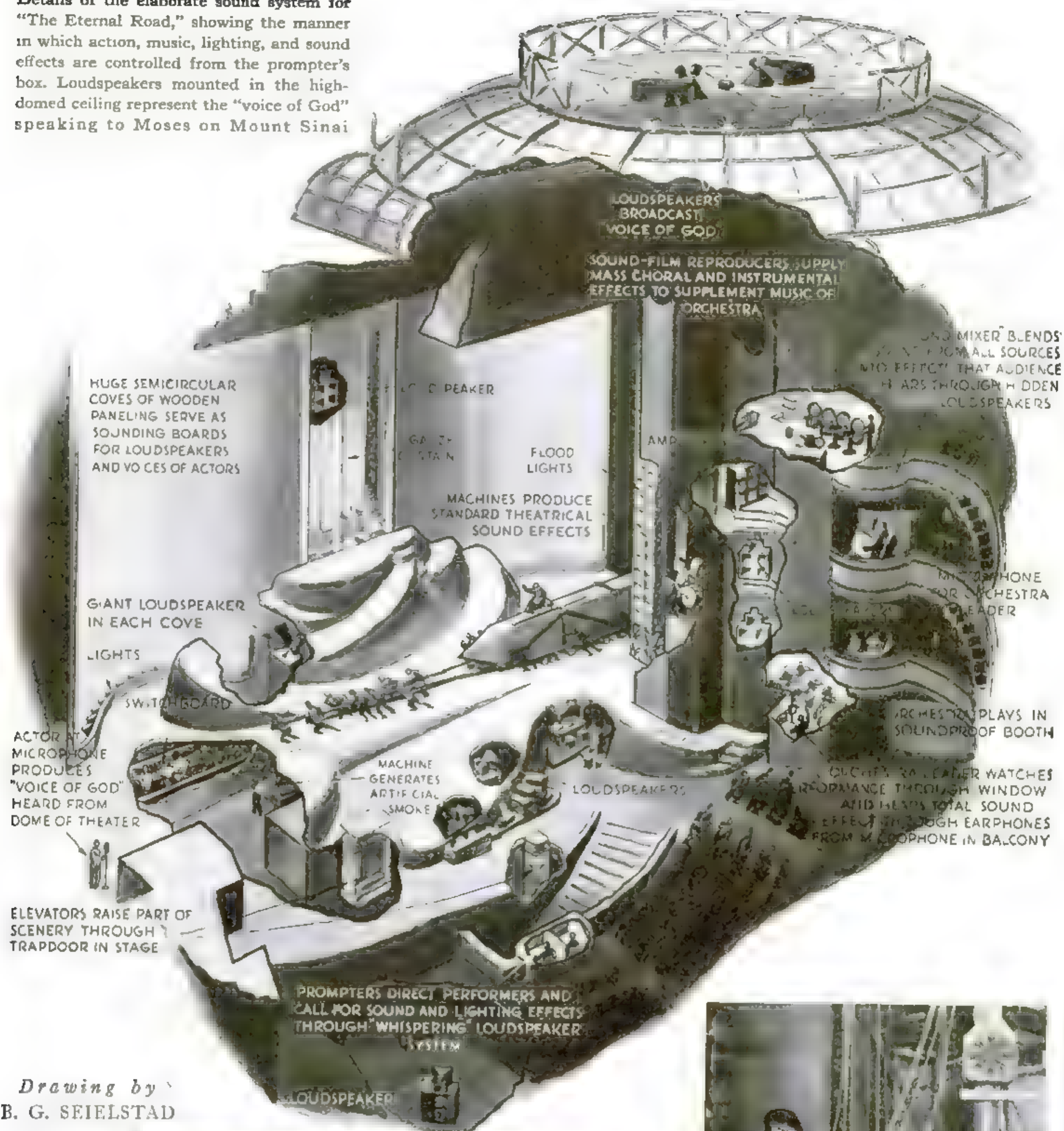
A scene in the dramatic spectacle "The Eternal Road," in which the strains of an orchestra, recorded choral music, and special sound effects are blended in loudspeakers



A loudspeaker unit facing one of the "coves," or sound-reflecting pockets that flank the giant stage on both sides and extend upward to a height of eighty feet

Black-hooded stage hands shifting scenery on the darkened stage. At left, the orchestra playing into the microphone in its soundproof booth

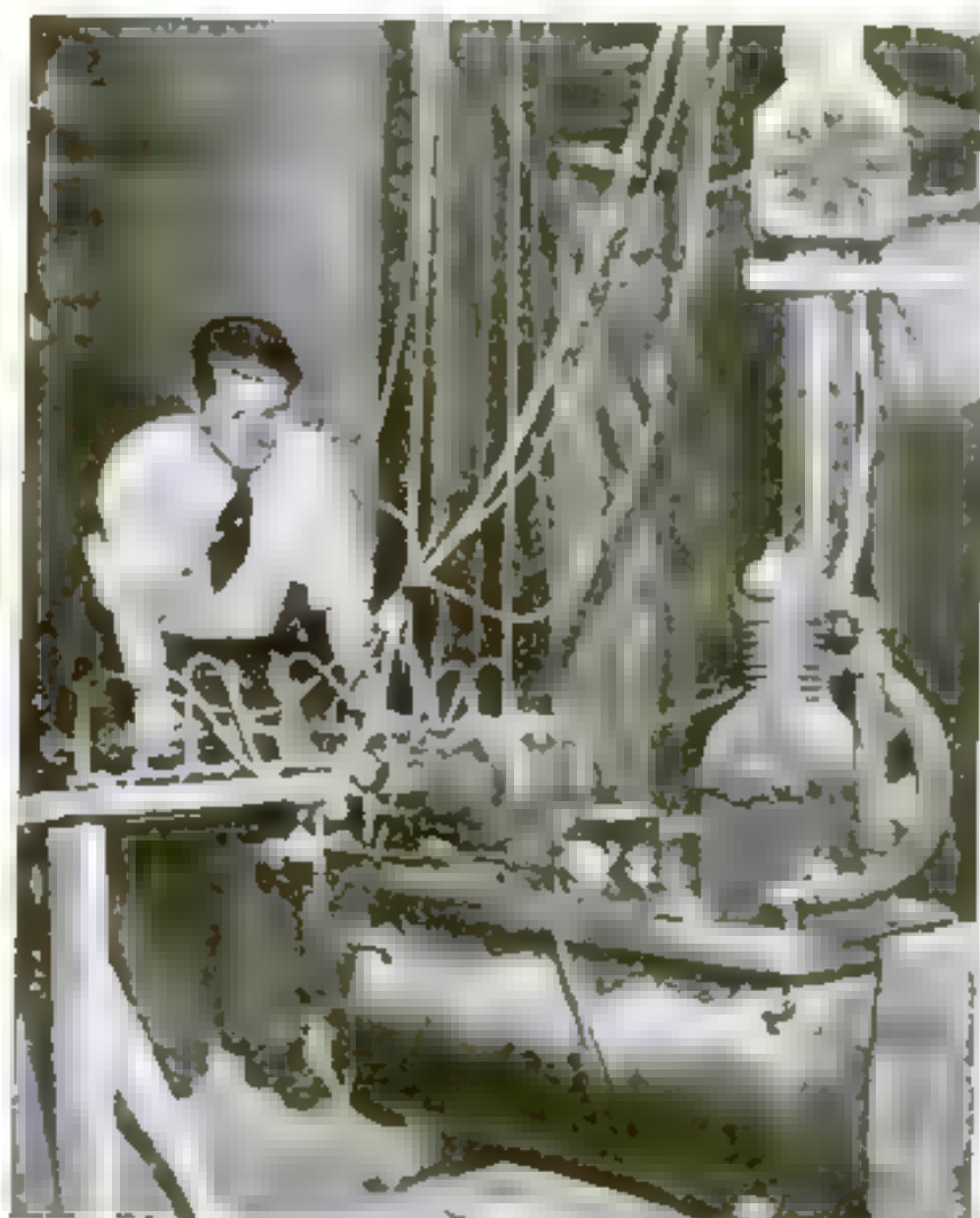
Details of the elaborate sound system for "The Eternal Road," showing the manner in which action, music, lighting, and sound effects are controlled from the prompter's box. Loudspeakers mounted in the high-domed ceiling represent the "voice of God" speaking to Moses on Mount Sinai



Drawing by
B. G. SEIELSTAD

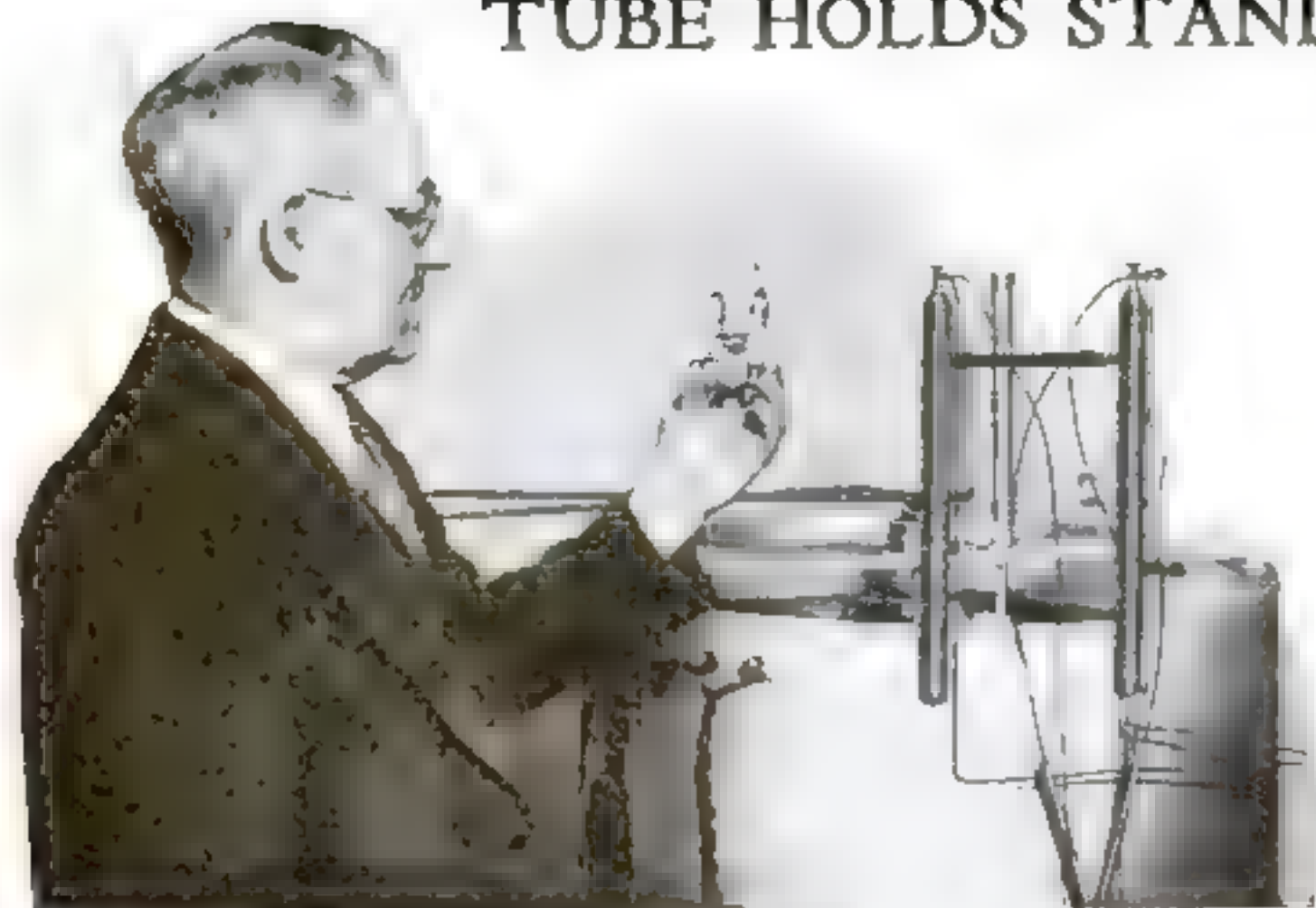
NERVE CENTER OF THE SHOW

From the prompter's box, located at the front of the stage, these men direct the actors and technicians. The one at the right handles the lighting, and the other controls the making of the sound effects



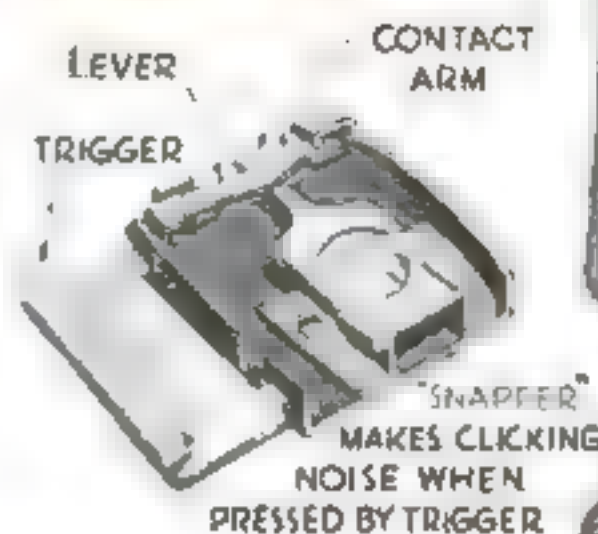
The operator of the smoke machine waiting for a "cue" which will come to him through the loudspeaker visible at the upper right

TUBE HOLDS STANDARD VOLT



A "yardstick" of electrical measurement—a cell that generates one volt

CONTAINING a cell that supplies exactly one volt of electricity, an H-shaped glass tube serves as a standard unit of electrical measurement in the General Electric laboratories at Schenectady, N. Y. Kept in an oil bath in an air-conditioned room, the tube is checked once a year with similar units of the U. S. Bureau of Standards.



WRIST "SNAPPER" HELPS CORRECT GOLF SWING

WORN like a wrist watch, a new golf accessory is designed to aid beginners to develop the correct swing with a club. As the wrists are bent at the top of the backstroke, a projecting arm on the device is tripped and a snapping sound produced, thus making the golfer conscious of the movement.

COPPER DANCE FLOOR

WHAT is said to be the world's first dance floor made of metal has just been installed in a fashionable London, England, night club. Sheets of glistening copper polished to a mirrorlike finish have been skillfully laid to form a smooth surface that is called ideal for dancing.

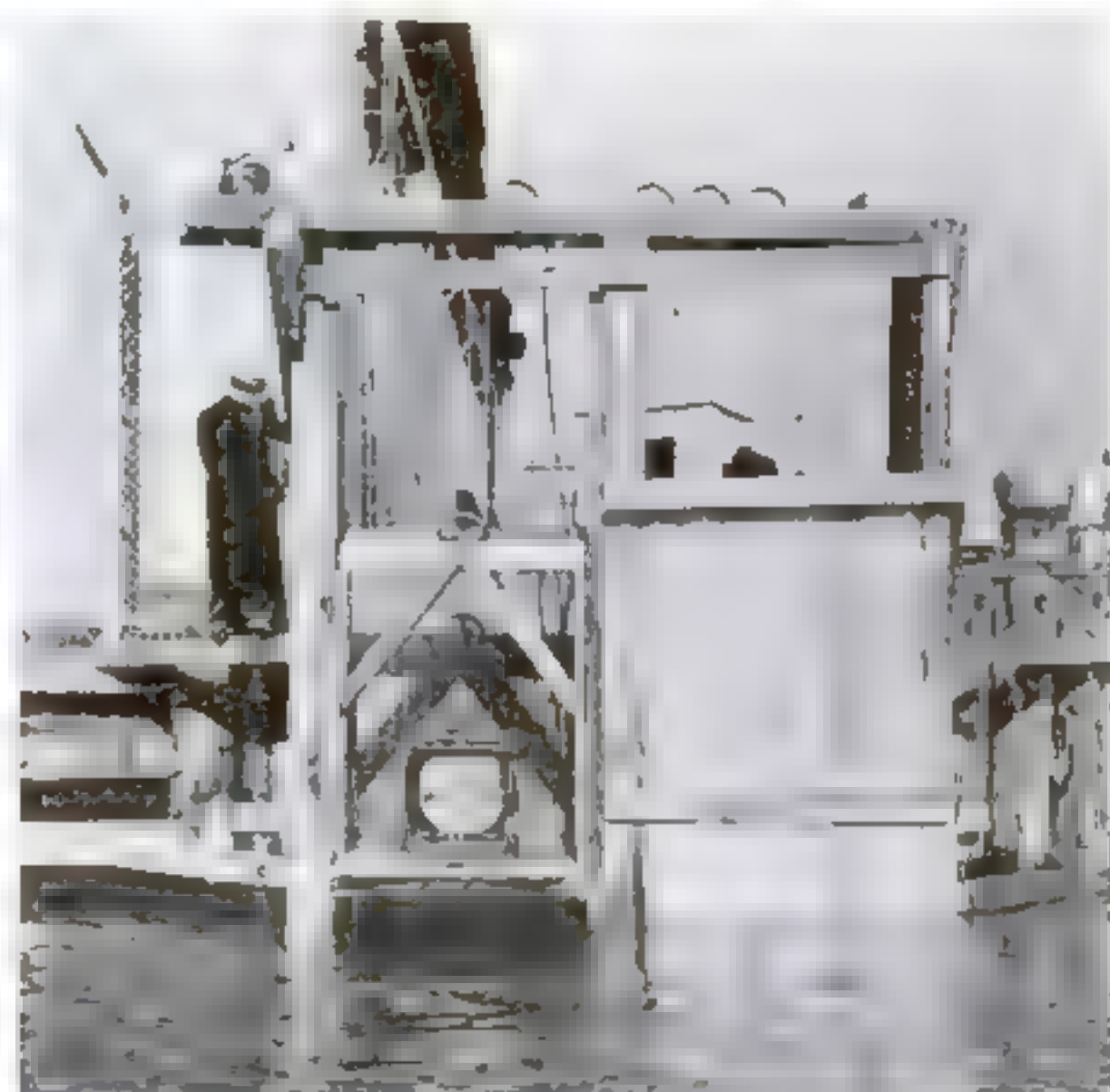
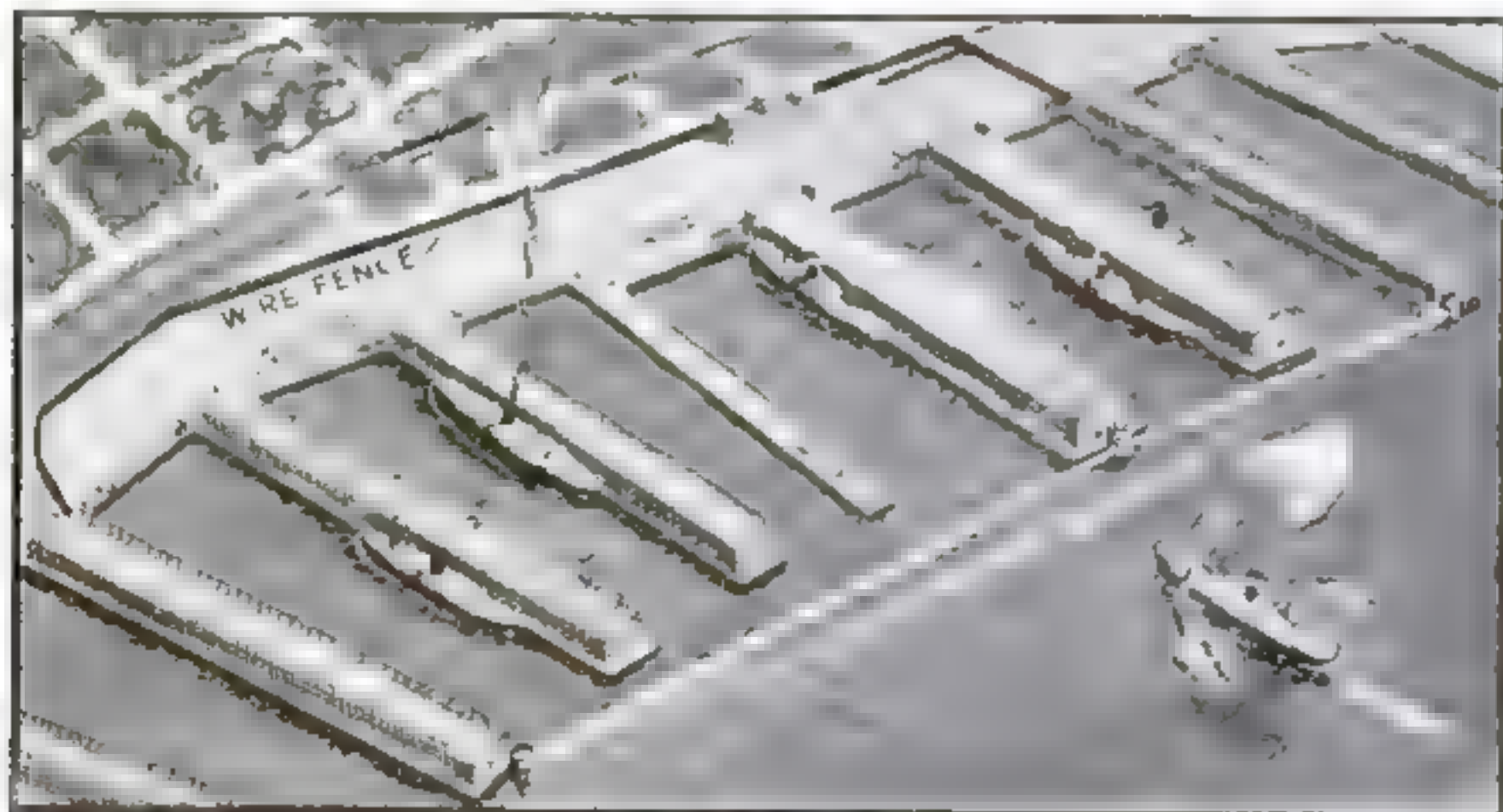
BATTERY-OPERATED PLANE BEACONS USE NEON LIGHTS

OPERATED by individual storage batteries, bell-shaped neon lights have just been introduced in England for use on air routes and at landing fields. When used as a signaling beacon, the lamp is flashed on and off by an automatic device to relay in code a continuous message of warning or airport direction. The beacons also are employed as portable boundary lights at landing fields, where their red glow is said to be visible at a distance of six miles. Sending keys can be connected to the lamps for signaling to planes not equipped with radio. The storage batteries supply a twelve-volt current.



Neon-light airplane beacon connected to key for signaling

"ELECTRIC EYES" GUARD WHARVES TO KEEP OUT SMUGGLERS



How powerful beams of light will block the entrance to the "free port." At the right is one of the "electric eyes" on a stage that moves up and down with tides



SKIMMING the surface of the water, beams of light will guard the entrance to a "free port" just completed at Stapleton, on Staten Island, in New York Harbor. Designed to aid international trade by providing a zone where foreign cargoes may be landed, graded, assorted, repacked, and reshipped without payment of customs duty, the port is the first of its kind to be established in the United States. While a high wire fence on shore

forms a land barrier to prevent the entrance of smugglers or other intruders, light beams stretch from the end of a central pier to the extremities of the port to guard against unauthorized entry by water. Any interruption of the beams by a boat, or even a swimmer, will actuate "electric eyes" to sound an alarm at port headquarters. To allow for tidal changes, a counterbalanced unit will keep the "electric eyes" always at water level.

Mississippi Flood Control

GETS FIRST REAL TEST

A GAINST a \$325,000,000 system of floodways, cut-offs, and levees, nature has just hurled a Mississippi superflood. High-water levels surpassing all-time records have tried out the untested flood-control works erected by U. S. Army Engineers since the disastrous flood of 1927.

At Cairo, Ill., junction of the rising Mississippi and the swollen Ohio, came the first dramatic test. As the bottle-necked waters neared the top of the city's sixty-foot sea wall, engineers dynamited a "fuse-plug" levee that sent a yellow torrent surging into the \$21,000,000 Birds Point-New Madrid Floodway—a 131,000-acre overflow basin diked off from surrounding country for just such an emergency.

New levees held the angry waters in check as they coursed down the 1,000-mile stretch from Cairo to the Gulf of Mexico. A dozen "cut-offs," or artificial channels dredged across kinks in the old river bed, lopped more than 100 miles from the path to the sea, to speed the flood waters' run-off and relieve pressure on the levees. At the new \$15,000,000 Bonnet Carré Spillway, just above New Orleans, La., engineers for the first time opened flood gates that acted as a safety valve for the river and diverted its excess water to the Gulf by way of Lake Pontchartrain.



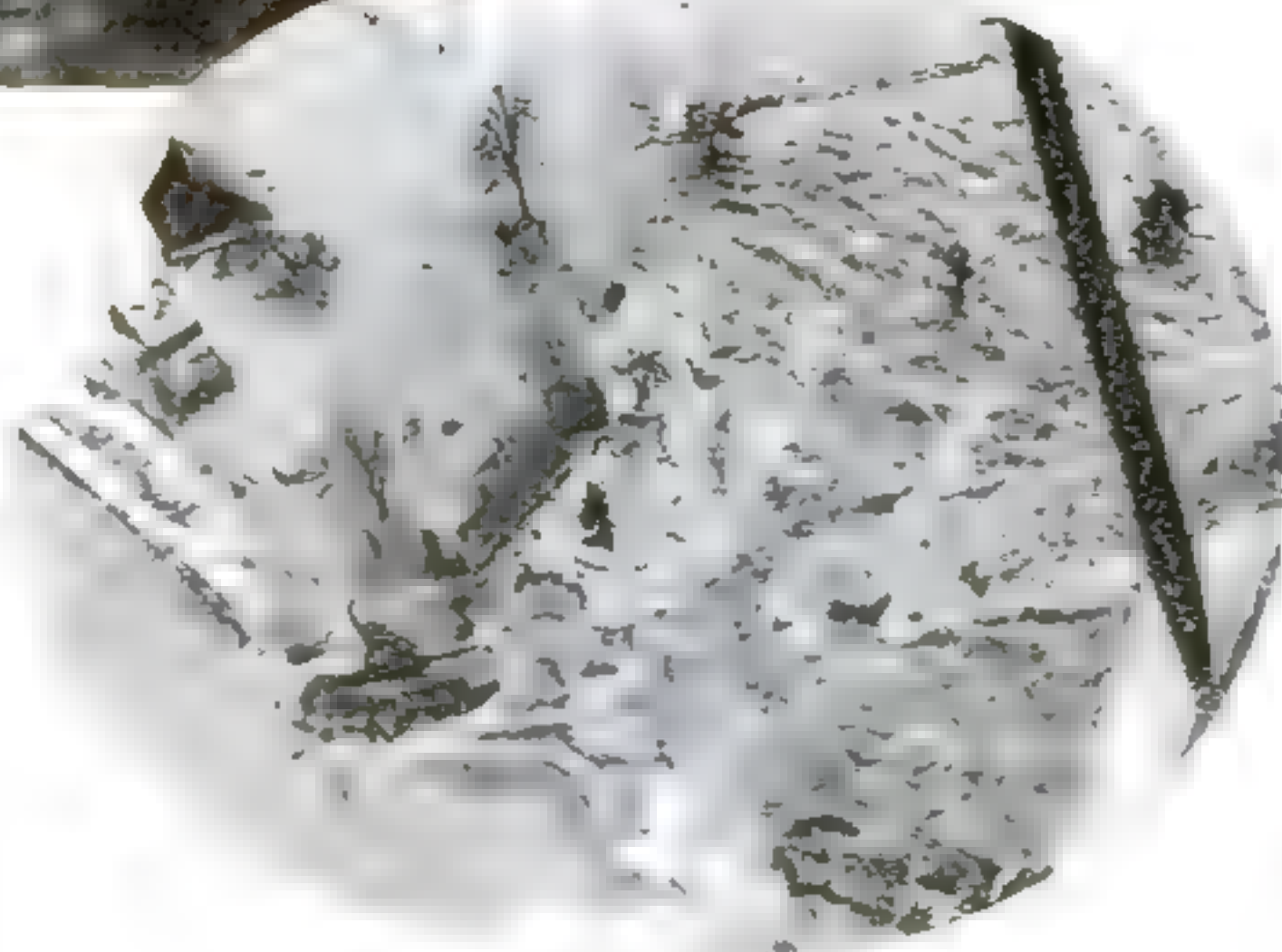
Workers piling sandbags on top of the levee at Cairo, Ill.



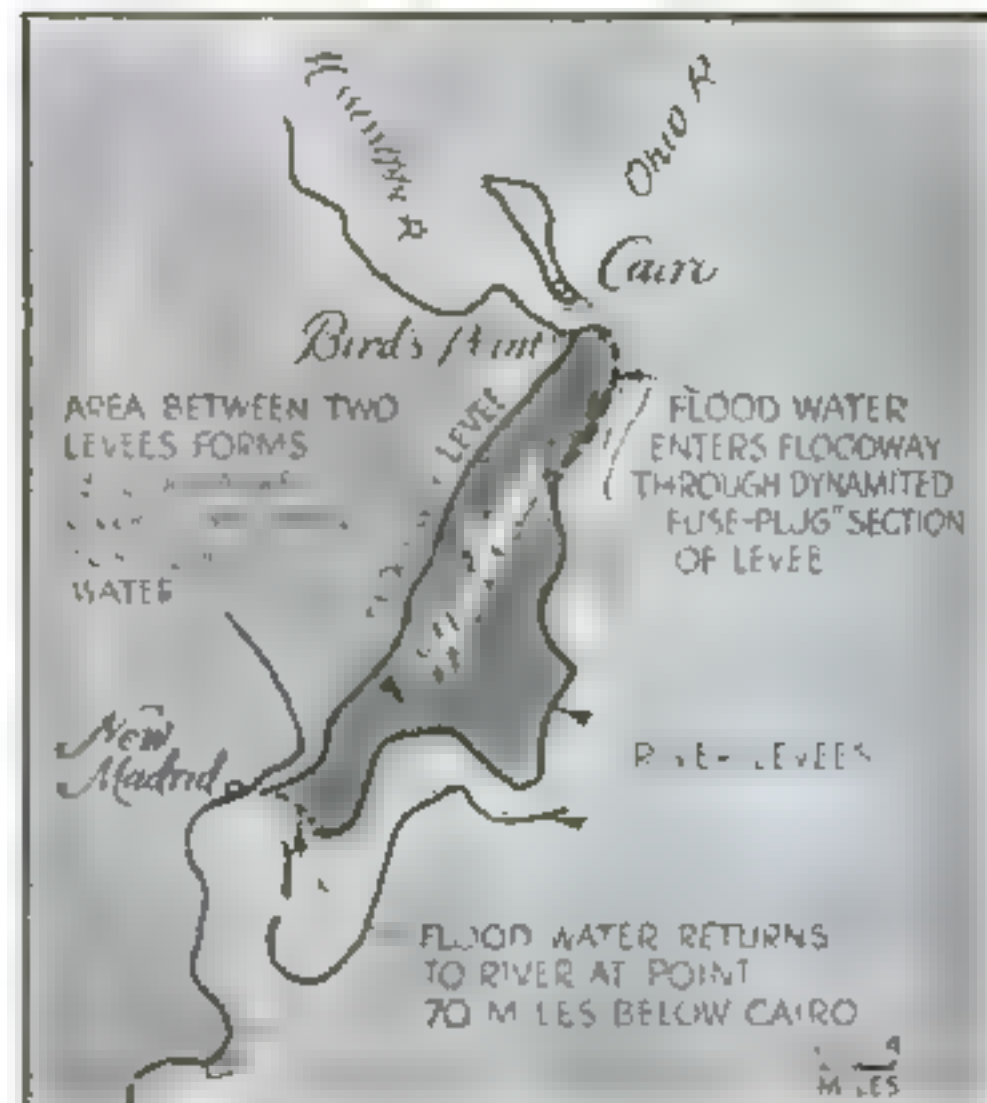
This remarkable photograph shows the blasting of the "fuse-plug" levee at Birds Point, Mo., to draw off water into the new floodway



An airplane view of the Bonnet Carré Spillway near New Orleans, La., through which floods are shunted into Lake Pontchartrain



Flood waters surging into the floodway below Cairo after the blasting of the levee. The 131,000-acre basin provides a short cut to relieve pressure in the "bottle neck" where the Ohio and Mississippi meet



This map shows the New Madrid Floodway, an important feature of the new flood-control system

HUGE BUNNIES MARK EASTER SEASON

GIANT RABBITS modeled out of plaster and tinted in brilliant colors prove a magnet that draws trade to merchants in a suburb of Kansas City, Mo. Scattered throughout the shopping district for the Easter season, the bunnies are illuminated at night by small spotlights concealed in gayly colored Easter eggs. Light bulbs that serve as eyes for the rabbits flash on and off to make the animals appear to wink.



The "eggs" conceal spotlights that illuminate this plaster rabbit in Kansas City, Mo.



LIFE PRESERVER HAS AUTOMATIC LIGHT

LIGHTING up automatically the instant it touches sea water, a novel life-preserver light makes it easy for rescuers to spot shipwreck survivors as they float about in the water. Made in the shape of a bullseye, the light is fitted with two specially prepared electrodes, one made of zinc and the other of carbon, that act like a wet-cell battery when they are submerged in salt water.

DEVICE PURIFIES AIR BY ELECTRICITY



The electric air purifier dissipating smoke in a demonstration. It also clears the air of dust, pollen, and other matter.

DUST, smoke, pollen, and other particles are removed from the air by an electrical purifier just invented for home use. Room air drawn into the device is passed through a high-voltage ionizing chamber where the dust particles become electrically charged. Blown into a second chamber, the charged particles are attracted to and collect on electrified plates. The device is expected to prove a boon to persons suffering from hay fever.

"PAINT" HOUSES WITH OILCLOTH

OILCLOTH is being substituted for paint as a protective coating for the outsides of frame houses. Walls are cleaned with sandpaper and a wire brush, and coated with a layer of rubber cement. Horizontal strips of oilcloth are then pressed firmly against the adhesive surface. Paper-hangers' tools are used to smooth the oilcloth coating and force it into the contour of the clapboards.

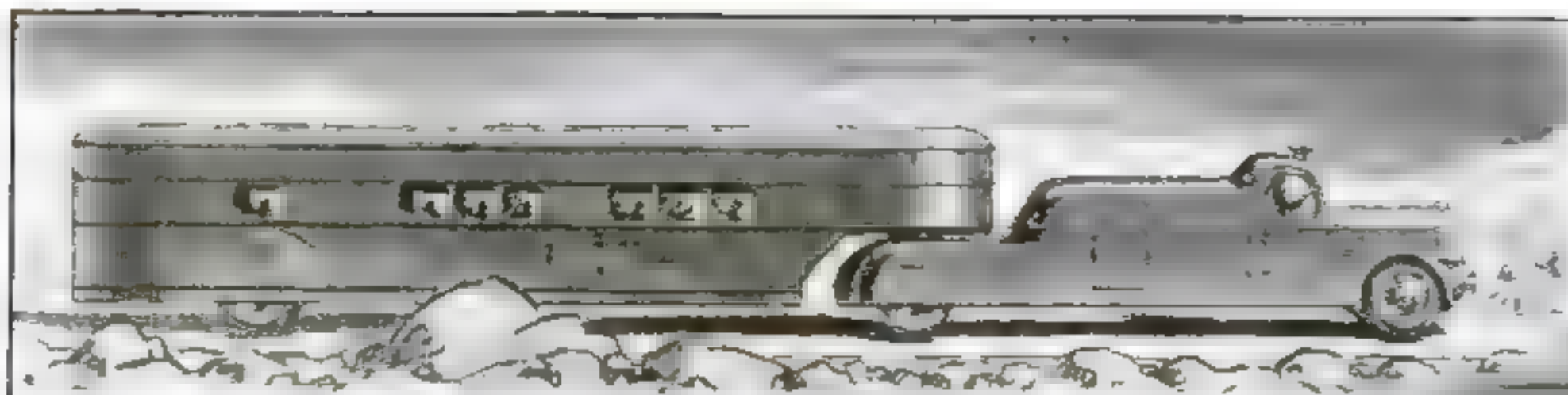


Strips of oilcloth being applied to the outside of a frame house. They are held to the surface by a coating of cement.



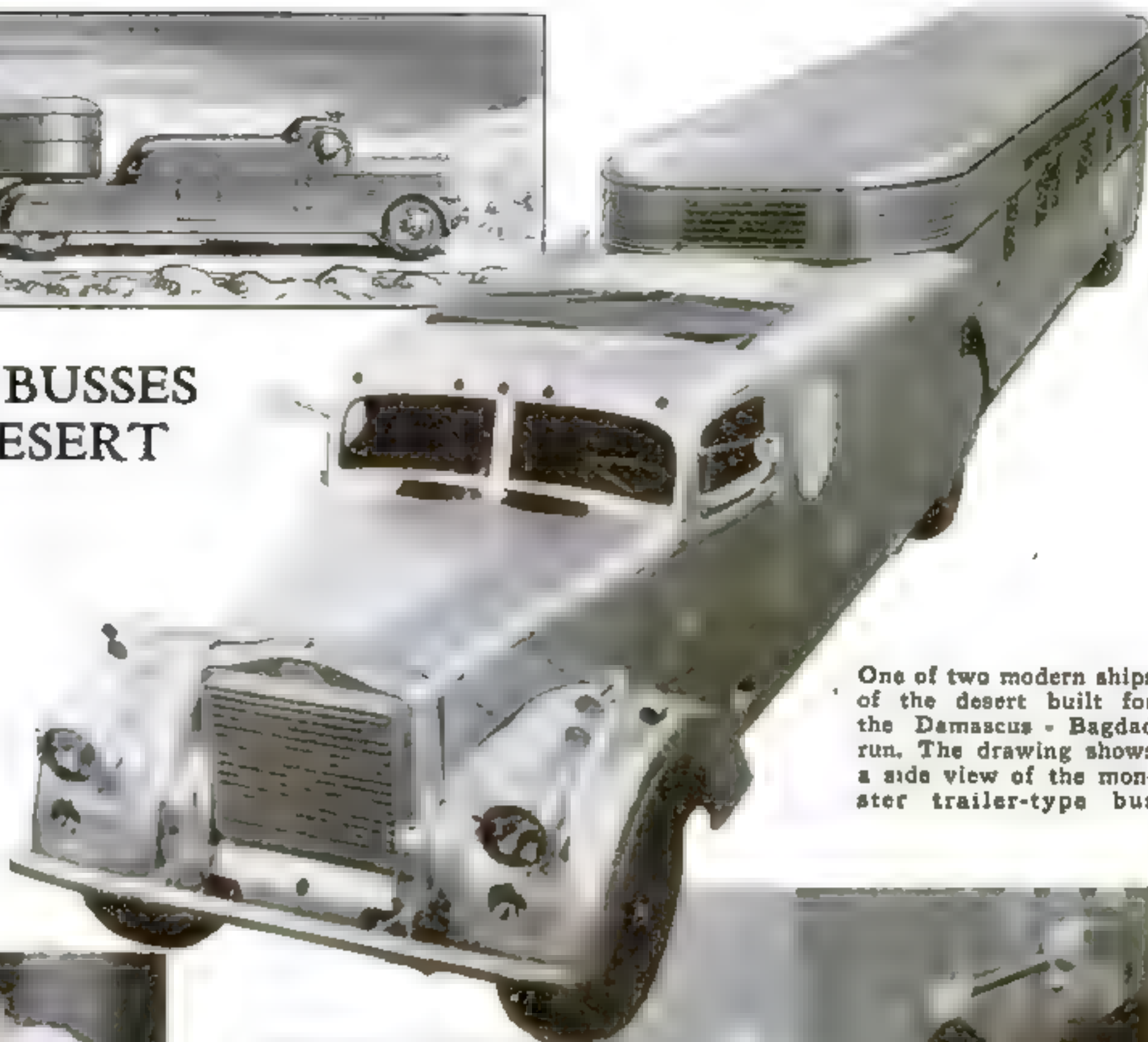
BUS SIGN SELLS BOOKS

NUMBERED plates, pulled down from the cross arm of a new type of street marker just installed in Germany, indicate which busses stop at that point. Used also as an advertising medium, the marker contains a slot machine that vends reading material to waiting passengers.



BIG STEEL TRAILER BUSES TO CROSS SYRIAN DESERT

DESERT SHIPS, in the form of stainless-steel, trailer-type busses pulled by 150-horsepower Diesel tractors, will link Bagdad, Irak, with Damascus, Syria, in a new high-speed service across the Syrian Desert. This 530-mile trip will be made with a single stop. Air conditioning and upper and lower berths will be features of the new transport service, which will cut the running time from thirty-five hours to fifteen. The big metal busses, each fifty-seven and a half feet long, were designed and built by a Philadelphia, Pa., firm.



One of two modern ships of the desert built for the Damascus - Bagdad run. The drawing shows a side view of the monster trailer-type bus



Light beams in a wall cabinet show results of indoor golf drives

LIGHTS MARK DRIVES FOR INDOOR GOLF

INDOOR golf tournaments are made possible by an invention recently demonstrated in New York City. Contestants drive a ball attached to strings connected with a recording machine. Beams of light on a miniature golf course show the results of each shot.



GARAGE FIXTURE TESTS OIL FROM CRANKCASE

DESIGNED for use in garages and filling stations, a new automatic apparatus enables the motorist to test the condition of his crankcase oil. A small amount of the lubricant is placed in the testing machine, which indicates the temperature of the oil, its viscosity, its color as compared with new oil, and the amount of dirt it contains. The device is shown in use in the photograph above.

PRACTICE MUSIC ON "SILENT" ORGANS

HALF a dozen music students can take lessons at once in the same room without disturbing each other, with a new electric organ perfected by an inventor in Chicago, Ill. Each player hears the strains of his own instrument through earphones.

The teacher, sitting in the midst of the "silent" organs, can tune in on the music being produced by any one of his pupils, and give individual instructions, when it is necessary, through a microphone connected to the earphones.



Students taking lessons on "silent" electric organs. Each hears the music of her own instrument by means of earphones, and the teacher can listen to any one and give instructions through a microphone

TABLE HOUSES CHAIRS

FOUR FOLDING chairs can be stored under the top of a novel card table recently placed on the market. Of drop-leaf design, the unit can serve as a wall table when not in use for games. The chairs fold up compactly and are stored in a rack suspended underneath the opaque plastic top.

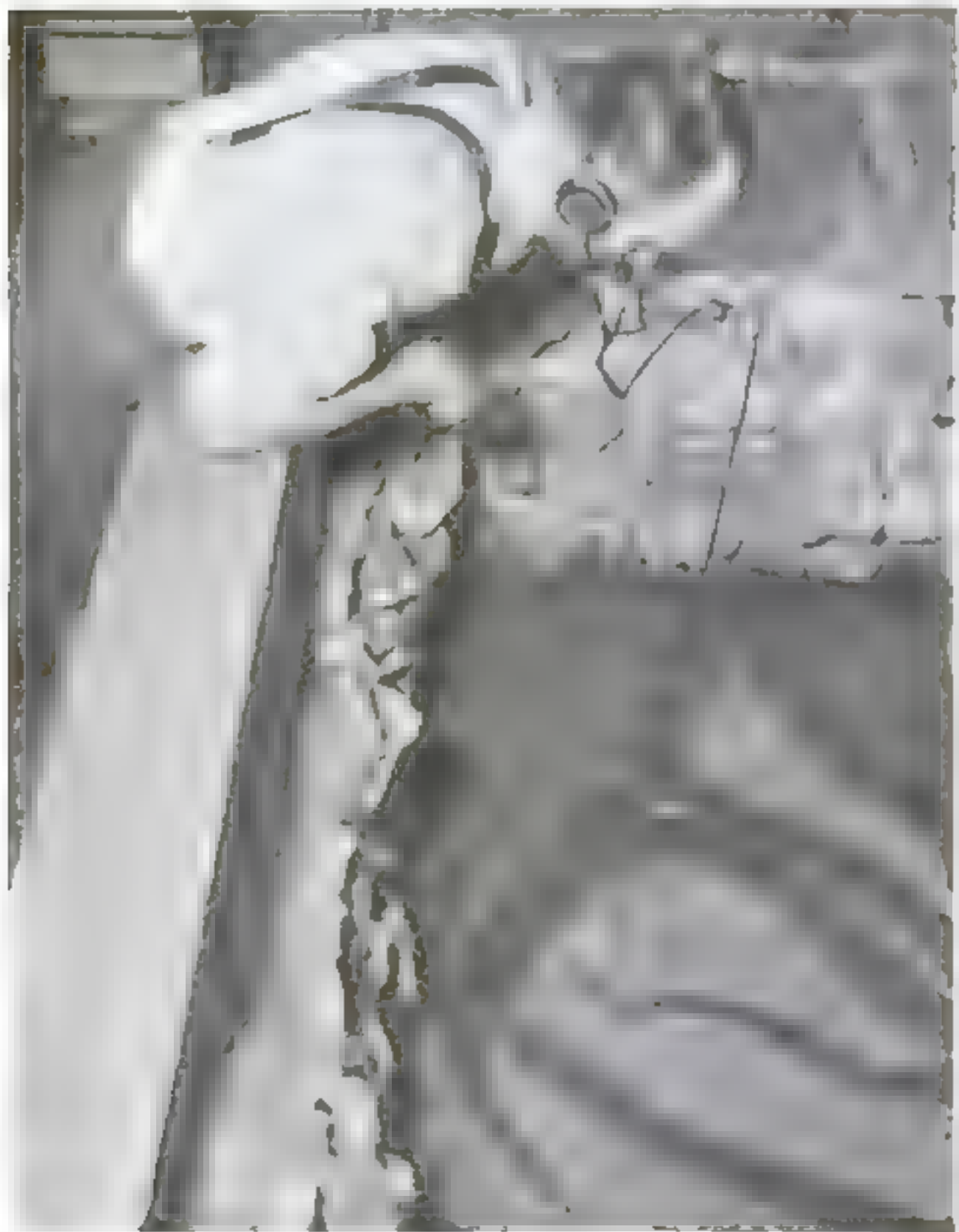
JUNGLE EXPEDITION

to study

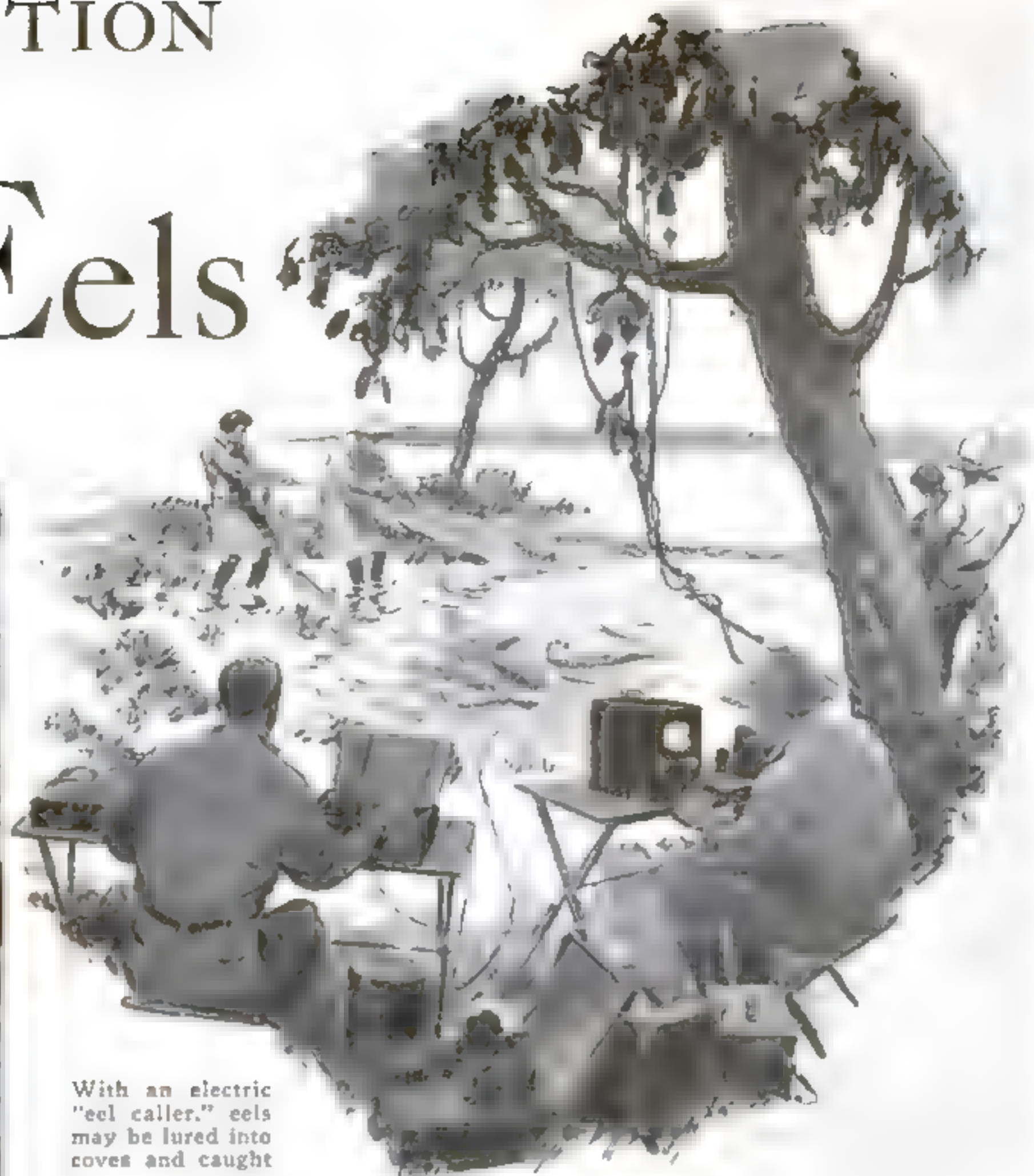
Electric Eels



In spite of its small size, this baby eel can deliver a shock that will put a man out of commission for the rest of the day. Note that the experimenter is handling it with rubber gloves



An observer "listening in" on eels. When he dangles the tips of the headphones in the water, he hears "static"



With an electric "eel caller," eels may be lured into coves and caught

With Amazing Instruments and Apparatus, Scientists Will Try To Solve the Mystery Of Nature's Swimming Galvanic Batteries

By ALDEN P. ARMAGNAC

TO LEARN how giant electric eels generate currents that can shock a man into unconsciousness, Dr. Richard T. Cox, New York University physicist, has just led one of the most curiously equipped of scientific expeditions to the native haunts of these strange creatures in Brazil.

In one of the pieces of apparatus taken along, a seven-foot trough lined with wires, live electric eels will be placed to tap their current. Another device, called a "cathode-ray oscillograph," will record the nature of the eel's electrical discharge.

A third appliance, the strangest of all, has been nicknamed an "eel caller." Housed in a small, oblong wooden box, it produces a realistic imitation of an electric eel's current when a button is pressed. With its aid, the expedition will test the recently advanced theory that the eels use their natural "shocking power" to communicate with each other, as well as to stun their prey and defend themselves against their enemies. If results support the theory, the party hopes to employ the "eel caller" as a decoy to lure large numbers of eels into landlocked coves. Then men clad in rubber gloves, aprons, and boots, as a protection against shocks, will capture them in nets for further scientific experiment and for exhibition in museums.

South American natives live in terror and hatred of the electric eel—and with good reason. Specimens eight feet long and about a foot in diameter are not uncommon. Endowed by nature as swimming power plants, the formidable black creatures infest fresh-water ponds and marshes of Brazil and Venezuela. Men and mules cross a ford in a trail at their peril. A lurking eel, disturbed by their intrusion, may knock them from their feet at any moment with a terrific electric shock. Unless help is near, the repeated discharges of the startled eels prevent the victims from regaining consciousness, and they drown. Electric eels also use their shocks to paralyze the frogs and fish on which they feed, so that their prey cannot escape them.

Pioneer experiments with captive specimens, conducted jointly by Dr. Cox and C. W. Coates, director of the tropical-fish department of the New York Aquarium, have recently revealed many of their secrets and laid the groundwork for the present expedition.

By dipping wires into a tank containing a six-foot electric eel, the experimenters made it light a neon lamp whenever it discharged. When they dangled the tips of a pair of headphones into a tank of electric eels, they heard crackling sounds like radio static. As a result, the Brazilian expedition plans to establish observers with headphones at "listening posts," to detect the presence of eels, in the marshes of Marajó Island, located at the mouth of the Amazon River.

That eels may signal to each other electrically was suggested by observations in the same tank. When a lone eel at one end of the pool discharged its current, a group of eels at the opposite end came swimming over to join it, as if summoned by some sort of telegraphic message.

If eels do talk with each other electrically, their code "language" may consist of at least two "words," tests with the cathode-ray oscillograph showed. The instrument revealed the hitherto unsuspected fact that electric eels emit two distinct kinds of shocks, of high and low voltage respectively.

Full-grown electric eels pack a punch of at least 300 volts, the tests showed—enough to stun a horse. A shock from wires placed only an inch apart on even a baby eel's body will give you a stiffer jolt than an encounter with a defective light socket. Oscillograph tests show that the shock from an eel is a series of high-voltage, direct-current discharges lasting about one one-thousandth of a second apiece and following one another with split-second rapidity. The eel's current can be closely simulated by discharging radio-type electrical condensers, which are used in the "eel caller."

That much is known about the electric eel—and the fact that the source of its strange power is a "battery" of thousands of electric "plates" of modified muscular tissue, arranged in longitudinal columns and completely occupying the latter five sixths of its body. How electric eels turn their current on and off seemingly at will, how they keep themselves from "short-circuiting," and why they are immune to each other's discharges and their own, are among the remaining mysteries that the Brazilian expedition seeks to solve.



When an eel is placed in a wire-lined trough seen at the left of the picture, the "shocking power" of different parts of its body is shown in a cathode-ray oscillograph



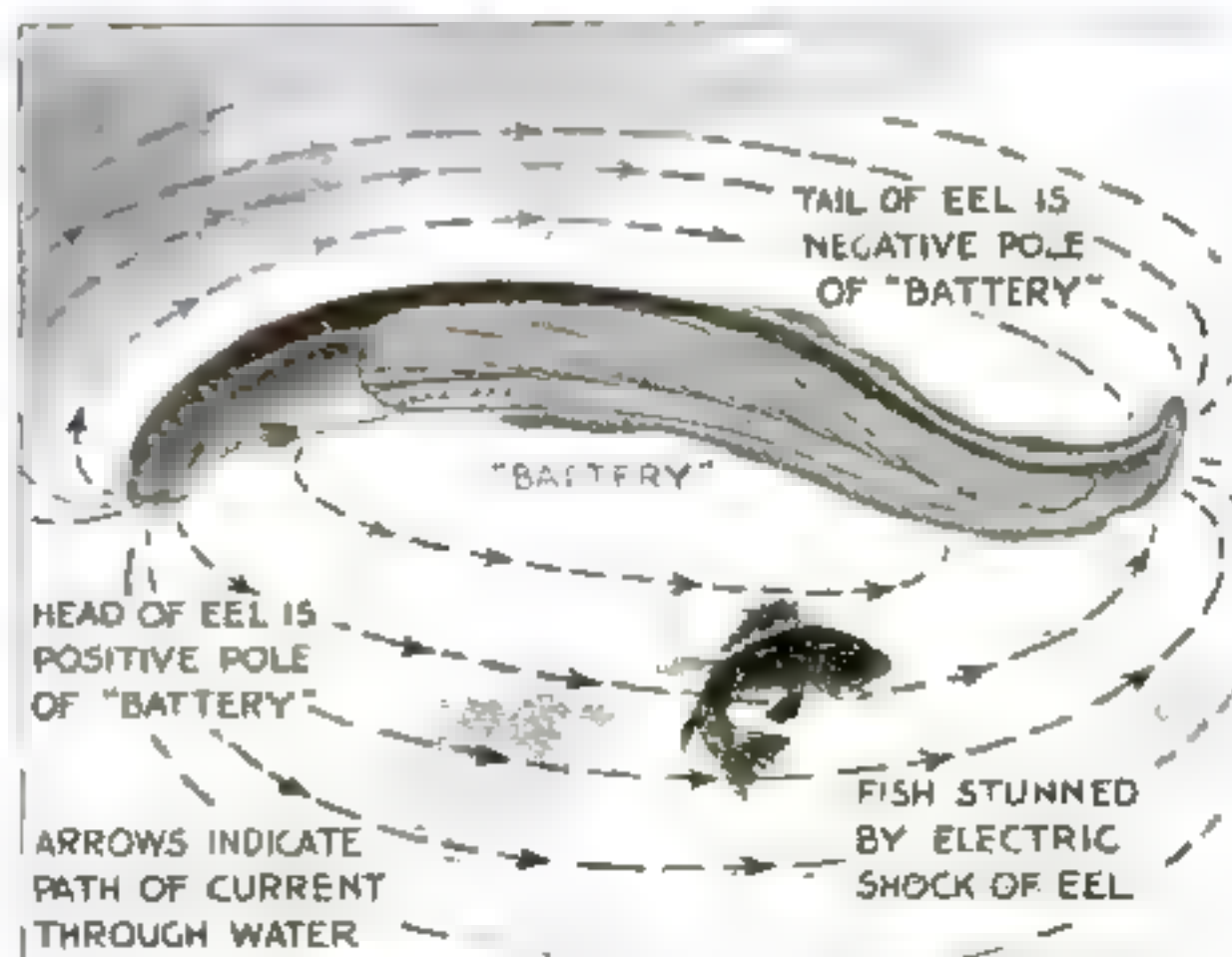
This observer is using a T-shaped electrode to measure electricity from a large eel inside the tank



The trough that taps the eel's current. Carefully spaced cross wires are laid along its inner surfaces



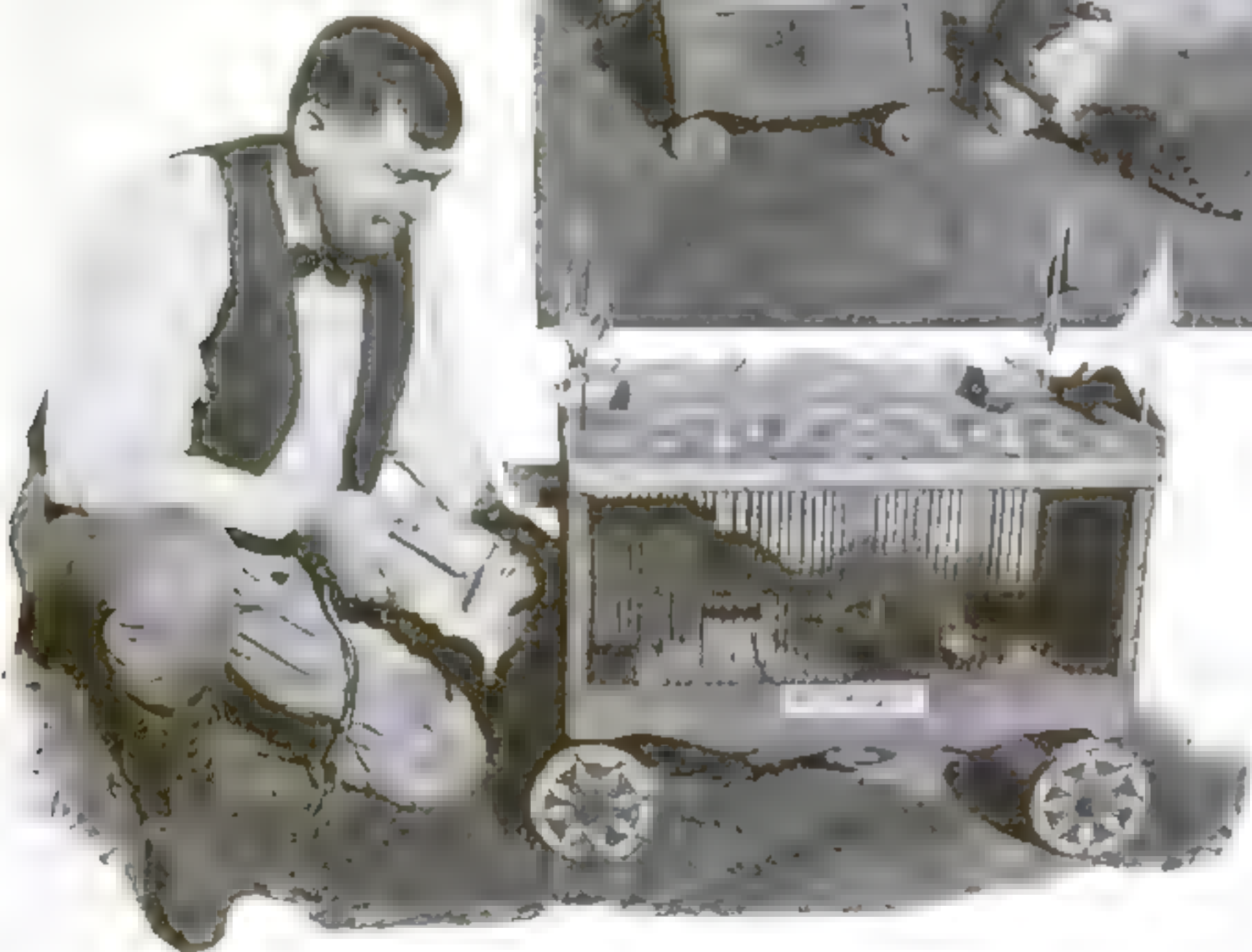
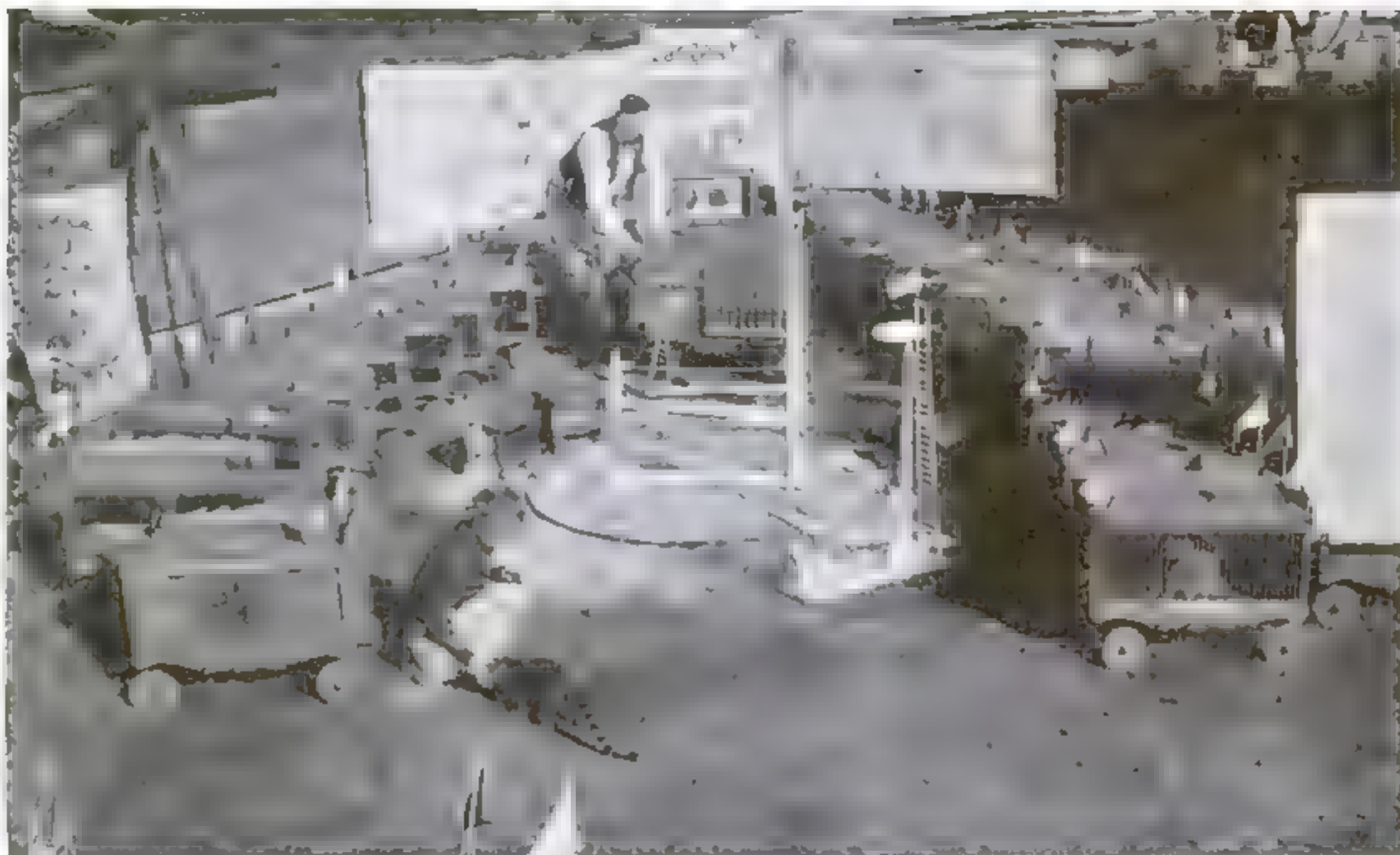
At the left is seen the "eel caller" that imitates the electrical discharge of an eel when the button is pressed. Condensers of radio type produce the effect. If eels communicate by electric shocks, this machine will be used for luring them



The drawing above illustrates the generally accepted idea of the way in which electric eels generate and use their current. The "battery" consists of thousands of layers of muscular tissue and occupies five sixths of the eel's body

THE PINT-SIZE CIRCUS COMES TO TOWN

Hickman's Miniature Circus set up for a show, with its twenty-four wagons drawn up around the garden-hose ring. Thirty kinds of animals are exhibited. Below, the owner, M. C. Hickman, is placing a small electric heater in the marmoset's cage to keep the exotic animal warm



Miniature Circus IS 'BIGGEST' LITTLE SHOW ON EARTH

COMplete to ticket wagon and calliope, a twenty-four-wagon circus carries with it thirty species of animals and reptiles—and the whole show can be displayed in a living room! M. C. Hickman, a garageman of Los Angeles, Calif., built the circus in his spare time, and it became so popular that he is now showing it all over western United States. The show is carried in a motor truck.

Hickman started the circus with a cinnamon ring-tailed monkey which he used to keep on display in the window of his garage. Later he acquired a few Russian hooded rats, and found that peanuts would lure them to perform a few simple tricks. Then he built a tiny wagon in which to haul them from home to office, and from that simple beginning worked up an entire circus, complete from performing rats and singing owl to tiny three-year-old alligators.

As the featured performers, rats work willingly, making a "slide for life" down an inclined wire, jumping ten feet from a tiny platform through a hoop of fire, and walking a tight rope. The circus ring consists of a coiled length of garden hose. Here the tiny calliope plays recorded music through a loudspeaker, and the monkey-

faced owl screeches an accompaniment, while the monkey takes up the tickets from customers. In all performances, Hickman is aided by his eight-year-old daughter, Donalee, who handles the animals as casually as other children play with puppies.



One of the show's star performers, a Russian hooded rat, about to make its death-defying leap through a flaming hoop into a net. A peanut is its reward

At the left, Hickman's daughter and assistant, Donalee, is ushering a rare Brazilian reptile into its exhibition cage

School for Watchmakers

*Trains
New Craftsmen
for an
Ancient Art*

BESIDES being famous for fine watch-making, Switzerland is a training center for this highly skilled work. In schools designed specially for the purpose, boys and girls from all over the world enter, at about the age of fifteen, on a four or five-year course of study and practice in building and repairing timepieces. At the end of their training, they pass an examination and receive diplomas. The photographs on this page show typical scenes in one of the oldest of these unusual institutions, located in Geneva.



Prof. Eugene Jaquet explaining to a class of eager students what makes the wheels go 'round. Large-scale models are used to demonstrate the working of various parts



At the left, pupils are learning to use machine tools at a bench. This training prepares them for possible employment in mass-production watch-making in one of the many large factories that produce quality timepieces



Because time is based on astronomy, students are given an understanding of the movements of the heavenly bodies. Here a group is being initiated into the mysteries of the solar system with the aid of an orrery, or small planetarium

During school hours, every pupil must wear felt slippers like those seen at the right. This is to eliminate noise and vibration, and to protect the many delicate instruments



A classroom scene. Instruction is theoretical as well as practical, and the four or five-year course of study includes a thorough drilling in the scientific principles involved in watchmaking. Graduates receive a diploma that gives them a high rating in the craft

Toilet accessories and furnishings are kept conveniently on the rack illustrated at the right. It holds the dog's own comb, brush, collar, and leash, with a tiny Scotty added just to give it a touch of elegance



This setter doesn't mind wearing a choke collar so much when the steel links are padded with leather to keep it from injuring the skin. Such collars are used with stubborn dogs



A rubber ball fitted with rawhide thongs is good for both playing and gnawing



In wet weather, the well-dressed dog wears a raincoat of rubberized silk, with a collar to protect the neck and throat. It ties easily around the waist with a single cord, as seen above

Comforts for INVENTORS SUPPLY AIDS FOR

TO HELP keep the nation's millions of dogs healthy and happy, inventors and manufacturers everywhere are constantly producing new garments, eating utensils, beds, mattresses, and toys. Over \$300,000,000 is spent annually by dog owners for these ingenious products.

Many new devices spring from the needs of individual dog owners. In Los Angeles, Calif., I. S. Horne saw his cocker spaniel dip its ears into its food, then kick the dish over. He devised a "cocker cup," with a deep, narrow aluminum bowl set in a broad steel base. Aluminum is easily cleaned and helps keep the food wholesome, while the steel base will not upset easily. Kay Becker, a Hollywood housewife, invented overalls with a slide fastener up the back to keep her dog warm, protect furniture against shedding, and permit medical treatment without soiling chairs and rugs.

Another dog lover devised a raincoat, made of rubberized silk and fitted with a collar that keeps the neck and throat dry. One man, whose city-bred dogs suffered sore feet in the country, invented rubber boots which lace up the front like hikers'



The canvas mattress shown at the left is filled with cedar shavings to discourage fleas. An opening with a slide fastener makes it possible to remove the shavings for laundering



These overalls, made of cotton suiting and fastened up the back with a slide, keep the dog from catching cold. They also prevent shedding on furniture and carpets, or stain from medical treatment



Long-eared dogs can keep their ears clean by eating from a deep cup set in a wide base that won't turn over

Your Dog

KEEPING PETS HEALTHY

boots. Now his dogs race over rocky slopes without injury to tender pads. A sportsman refused to use a choke collar on his setter until he had the steel links covered with leather. The collar still chokes, but does not injure the skin.

New ideas spring up daily, all designed for making dogs happier and healthier. Puppies must have exercise, particularly when confined to the house. A rubber ball fitted with several strands of rawhide entertains dogs of all ages, and the rawhide, which is tasty to the canine palate, helps strengthen the teeth.

All dogs, to achieve pleasing appearance, must have toilet accessories and furnishings, including comb, brush, collar, and leash. Even the bedding has gone scientific. One owner, whose dog was bothered by fleas, ripped open the mattress, stuffed it with cedar shavings, and provided a slide fastener. Now the dog's bed may be emptied, laundered, and refilled with fresh shavings whenever necessary.

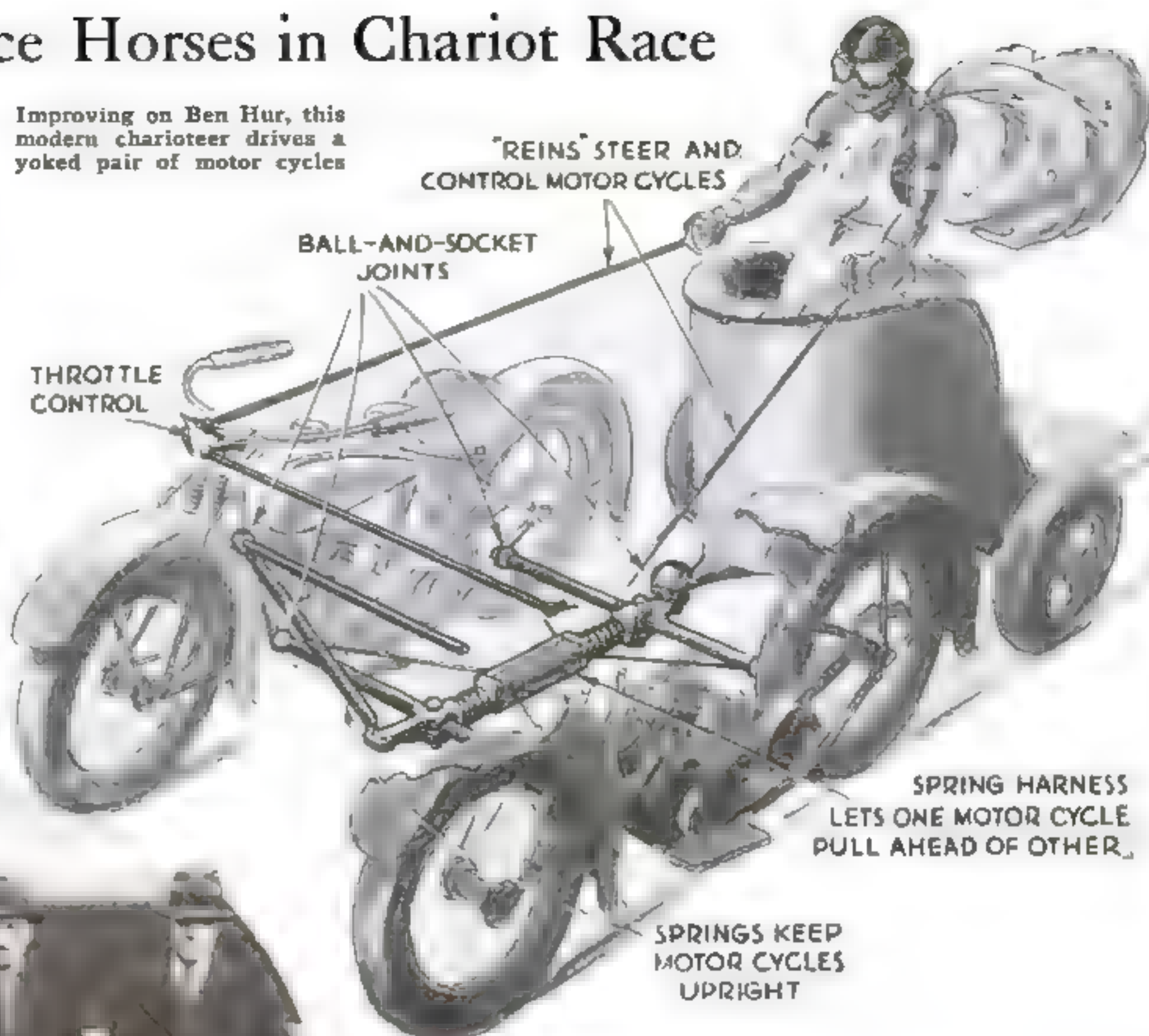


This spaniel is getting into his hiking boots for a romp in the country. Designed to protect the delicate feet of city-bred dogs against stones and cold, they are made of rubber and are laced on

Motor Cycles Replace Horses in Chariot Race

CHARIOT RACING, with motor cycles taking the place of horses, is the novel sport made possible by an ingenious coupling apparatus recently devised by an Iowa inventor. Tubular metal spreaders, fitted with strong steel springs and attached to each motor cycle by ball-and-socket joints, keep the machines upright while providing sufficient flexibility for tilting on banked turns. A spring-equipped harness allows one motor cycle to pull ahead of the other to maintain correct balance on sharp curves, and a two-wheeled chariot can be attached to the apparatus for use in racing contests. Rigid metal "reins" attached to throttle controls and steering posts are pushed or pulled by the driver to steer the twin motor cycles, and twisted to control the speed.

Improving on Ben Hur, this modern charioteer drives a yoked pair of motor cycles



PROPELLER WITH ONLY ONE BLADE TESTED IN ACTUAL FLIGHTS

IN A plane pulled by a propeller with a single blade, Jesse Jones, manager of the Lancaster, Pa., airport, recently completed a series of test and demonstration flights. The new type of air screw, seen at the left, is the invention of Walter Everett, of Baltimore, Md. In place of the conventional second blade, the propeller is equipped with a balancing weight to prevent vibration. According to the inventor, the single-blade screw is not only cheaper to manufacture but also more efficient in the air.

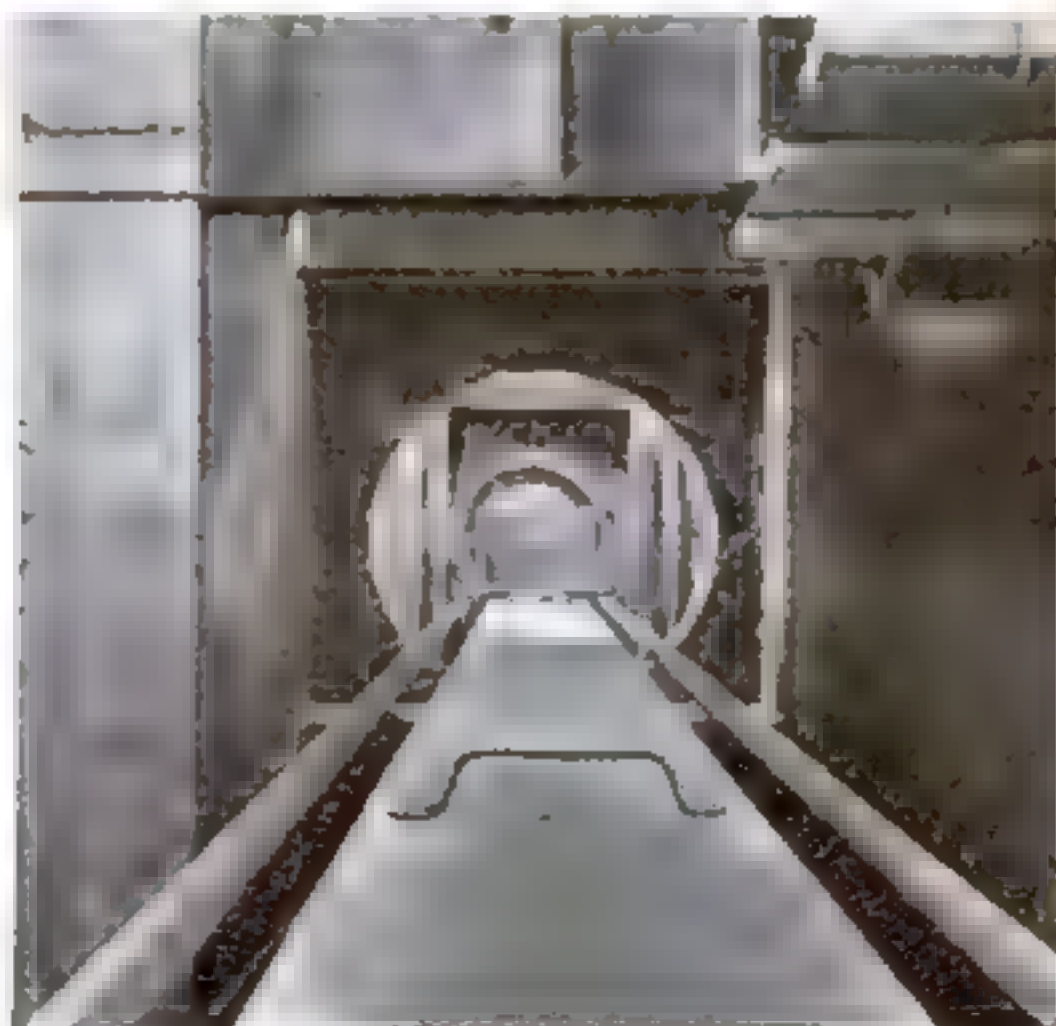


FLASH-LIGHT CAMERA TRAP GUARDS MILK FROM THEFT

PUTTING his professional knowledge to work, Charles F. Norris, a photographer of Portland, Ore., recently ended thefts of his milk by setting a "camera trap." Wires led from the milk bottle to a camera and photo-flash bulb, so that the moment a thief lifted the bottle, the light would flash on and the camera shutter would click. Apparently the mere flash of the bulb was sufficient protection, for after one "shot" the milk has remained undisturbed.

ODD ELEVATOR IS BUILT LIKE A BUCKET HOIST

WORKMEN at a soy-bean plant in Norfolk, Va., ride from one floor to another on a unique "endless belt" elevator, equipped with small platforms and hand holds. The laborers start and stop the elevator by pulling a rope hanging beside the belt. This unusual system saves space and provides economical transportation between floors.



A workman using the novel one-man elevator in a Norfolk, Va., soy-bean plant. The photograph at the left shows a view down the "shaft"

The Man



with the Net

NILE WATER contains a greater variety of fish than that of any other river in the world.

SUNFISH have brains that are longer than their backbones.

AMERICAN dictionaries list six names—puma, cougar, panther, catamount, mountain lion, and American lion—for the same animal.



INSECT HEARTS sometimes reverse themselves and beat backwards.

MILK is the only food used universally by man.

MAINE is the only state in the Union that is bordered by only one other state.

INHABITANTS of Great Britain shave off 50,000 miles of whiskers a day.



ST. WILLIAMS, S.C., has 130 inhabitants, all with the surname of Rogers.

TIN CANS are made in more than 6,000 shapes and sizes.

COLUMBUS brought the first cows to America in 1493, the year after his first voyage of discovery.



GLASS neckties, woven from fine fibers of glass, have been produced in various colors by a Corning, N. Y., laboratory.

CORRESPONDENCE-SCHOOL courses printed in Braille are now supplied to blind students by an Illinois institution.

CITIZENS of Honduras pay no taxes. The expenses of the government are met by duties on exported metal, hides, and fruit.



NEW SLOT MACHINES SELL ICE CREAM

ICE CREAM has joined the list of commodities dispensed by slot machines. The latest automats, recently installed in New York subway stations, hold 500 bricks apiece and use "dry ice" to keep them from melting. Inserting a coin permits the customer to open a door where the ice-cream brick is delivered.

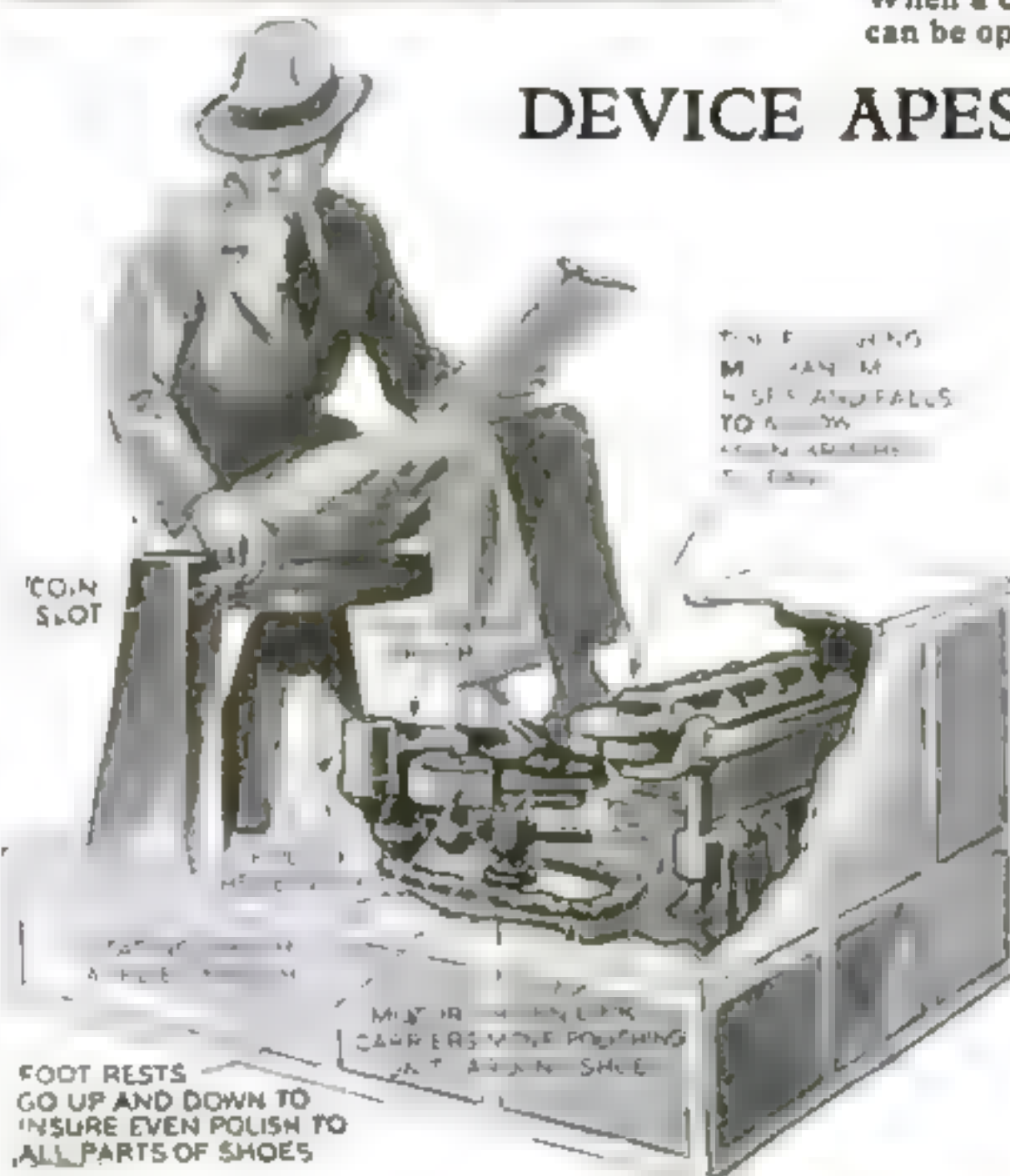
FILTER HELPS METER GAUGE USEFUL LIGHT

By screening out rays that the human eye sees poorly or not at all, a new filter of special glass, shown below, improves meters for testing useful illumination from neon, sodium, and mercury lamps.



When a customer drops a coin in the slot, a door can be opened and a brick of ice cream removed.

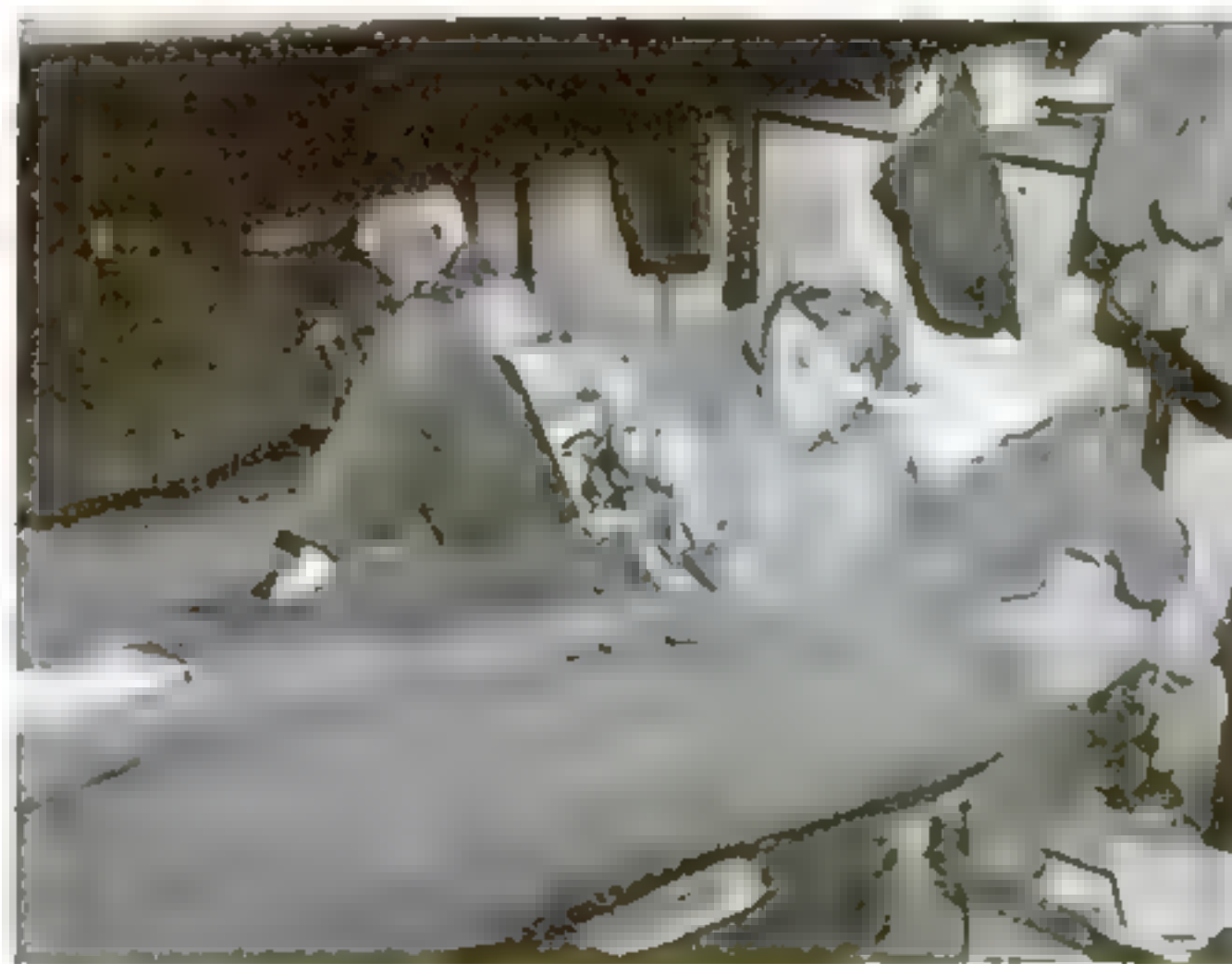
DEVICE APES BOOTBLACK



A **SHOE-SHINING** machine perfected by a Waynesboro, Pa., inventor does everything but brush you off and solicit a tip. Inserting a coin closes an electric circuit and actuates a maze of gears, cams, and worms that imitate the motions of a human bootblack with uncanny precision. Cleaning, blacking, and polishing brushes follow one another along an elliptical track as they make the circuit of the shoes, an automatic pump supplying just the right amount of polish at the proper moment. A buffer of lamb's wool applies the final touch. The entire operation, from start to finish, takes only 120 seconds.

P.S.M. FOLLOWS MOVIE COMPANY TO NORTH WOODS

WHEN the movie company for the production "Come and Get It" traveled into the depths of northern Idaho forests to film a log drive, **POPULAR SCIENCE MONTHLY** went along. The photograph at the right shows George Breakston, fourteen-year-old actor, enjoying his copy as the snowbound cast awaits favorable weather for shooting.



George Breakston, movie actor, enjoying his copy of P.S.M.

PLANS "AIRPORT" FOR ROCKET SHIPS



Design of "stratoport" for rocket ships carrying passengers and mail. Arriving craft plunge into a water-filled basin that cushions shock

TINY ALUMINUM SPLASH GUARDS PROTECT HOSE

LIGHTWEIGHT aluminum mud shields recently introduced in England protect women's stockings in rainy weather, much as splash guards on the rear fenders of automobiles prevent water from splattering up onto the car. Quickly slipped on or off, the shields are attached to small wires that clamp lightly but snugly around the ankle.



Water cannot splash up on stockings

NEW LICENSES ARE EASIER TO READ



The new plate compared with common type

AFTER long research, Prof. C. C. Wiley of the University of Illinois has perfected a new license-plate design said to be legible at a twenty-five-percent greater distance than conventional automobile plates. Slightly shorter and taller than the present type, the new license has numerals arranged in two rows, while state name and year are abbreviated at the side edges. The picture shows the plate compared with one now in use.

LOOKING forward to a day when rocket ships may carry passengers and mail, a French engineer offers a striking preview of an airport of the future. His design provides ten inclined launching ways for rockets, equipped with catapult mechanisms and radiating in all directions from the air field. While most rocket theorists envision a landing effected with the aid of a parachute, the French technician proposes a different solution. Checking speed by reversing its propelling apparatus, a rocket would plunge into a water-filled basin to cushion the shock of landing.



HAIRPINS ARE REMOVED BY PERMANENT MAGNET

Among the latest devices perfected by studio make-up experts in Hollywood is a permanent magnet designed to remove hairpins quickly. Moved about the head close to the hair, the magnet is said to attract and draw out the metal pins in an instant. In the photograph above, Dorothy Lamour, film star, is trying out the novel time-saving device.

ADJUSTABLE HOSPITAL

A LARGE hospital now under construction in Melbourne, Australia, will have movable interior walls and partitions. Wards and private rooms will be adjustable, allowing the interior of the building to be rearranged to meet emergencies.



Arrow shows the wire that gives warning when the car is alongside the curb

WHISKER IS GUIDE FOR PARKING CAR

ATTACHED to the underside of the right fender of a car a new device invented by Russell Hand of Pasadena, Calif., helps motorists to park. One end of a tin cylinder serves as a diaphragm to which is soldered a bent wire that extends out six inches from the car body. Whenever it scrapes the curb, the wire sets up a warning vibration in the cylinder, indicating that the car wheels are within short range of the curb. The original model of the device was made from piano wire and a tin can.



The wire "whisker" creates a vibration in a hollow metal cylinder

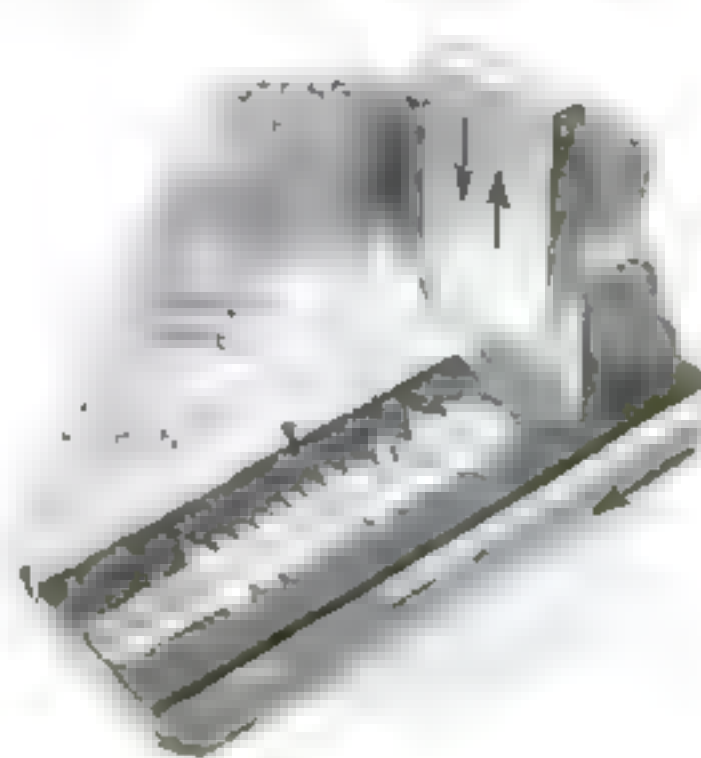


ROLLER-SKATE TENNIS IS NEW THRILL SPORT

ADDING a new and exciting element to the game of tennis, sport enthusiasts at Miami Beach, Fla., are playing on roller skates. The innovation is said to require exceptional skill, as the skates add to the difficulty of starting and stopping quickly. In the photograph above, Wes Aronson, star at the new sport, is shown executing a forehand drive.

SOUND TRACK IS CUT ON FILM

SOUND tracks are cut on film by a knife in a novel recording process just developed in Holland. Actuated by sound vibrations, a flat-edged recording blade moves up and down to cut into a moving celluloid ribbon which is coated with a dark, opaque layer. Thus, variations in the sound impulses result in white zig-zag patches of varying depth and width, as indicated in the diagram at the right. Unlike sound tracks photographed on film, the celluloid ribbon requires no developing before it is fed into a photo-electric pick-up unit for reproduction of the original sound. The system is said to give noiseless, clear reproduction.



How the new process records sound on an opaque film covering. The record can be fed into a reproducing device without developing



Moving film is cut by a vibrating knife, and fed onto a storage turntable

CANARY CHAMPIONS CHIRP IN CONTEST

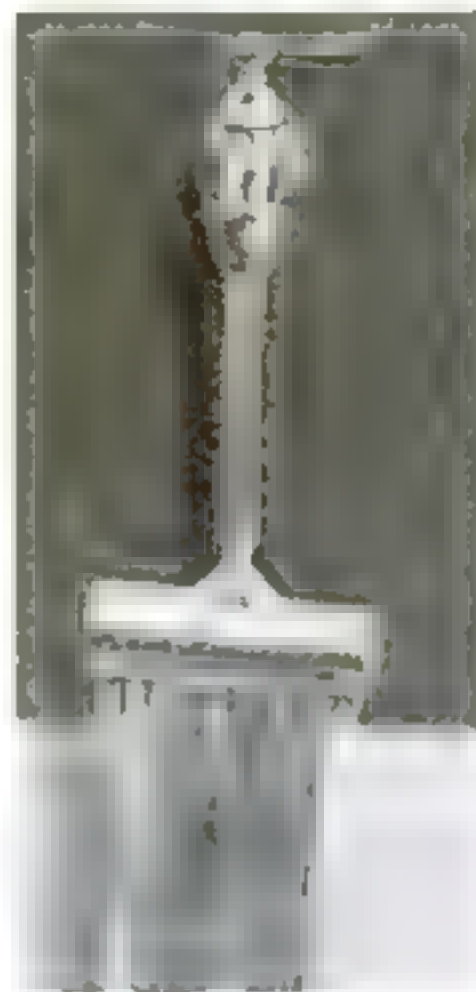
TRILLING and warbling in their individual cages, prize canaries recently competed in an international singing contest held in Paris, France. Led by a Belgian bird expert, four judges crowded around the feathered songsters to appraise the quality of the bird notes. Eleven birds won the right to chirp in the final judging, shown in progress in the photograph at the right, in which the champion was selected.



Judges comparing notes on eleven finalists in a canary singing contest

WIRES SHIELD POWER LINES

SHIELDING wires, connecting the tops of high-tension power-line towers, have reduced the number of short circuits caused by lightning to one fifteenth the usual number, according to recent tests conducted by General Electric engineers. The wire shields diffuse lightning strokes and help ground charges.



NEGATIVE WASHER FITS ON FAUCET

PHOTOGRAPHIC negatives of the roll-film type are easily washed with a novel accessory just marketed. The film is hung on pins from the lower edge of a perforated metal cylinder which is connected to a water faucet by a length of rubber hose. When the tap is opened, water flows into the cylinder and then streams down through the perforations over both sides of the suspended negative. The washing unit fits any faucet and can be used with all sizes of roll film.



STRETCHER HAS GASPROOF HOOD

TO PROTECT ill or injured persons while they are being transported to a hospital during a wartime gas attack, a novel stretcher has just been developed in England. An air-tight canvas hood, fitted with celluloid windows, is held over the patient's head by a tubular bar and connected to oxygen-filled cylinders attached to the stretcher supports.

Five Weeks



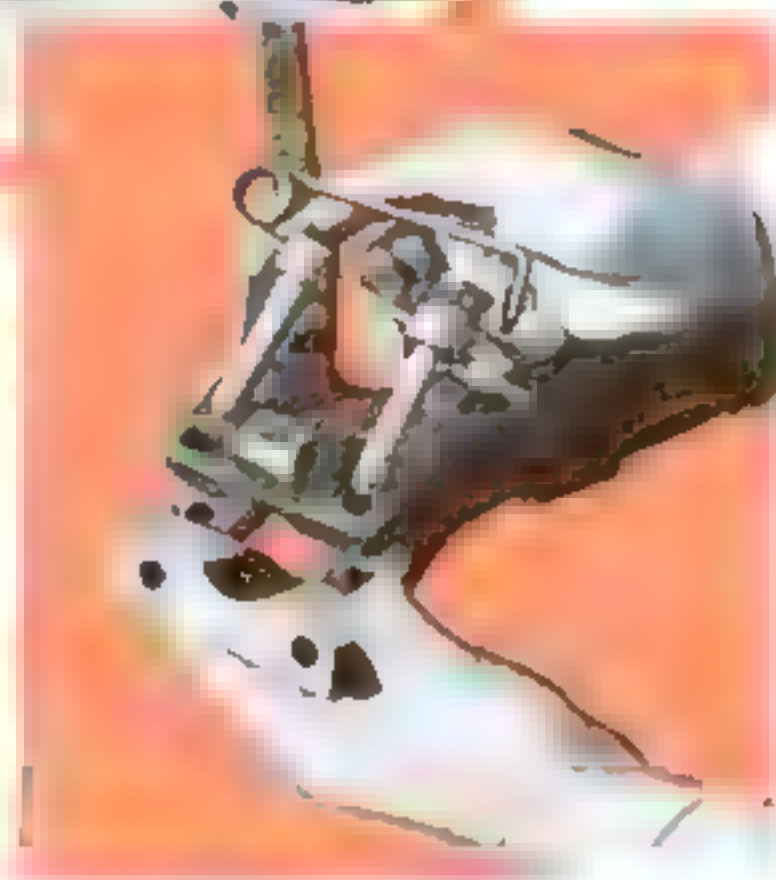
The author's "rolling home" parked at the giant trailer camp at Sarasota, Fla., Mecca of modern nomads



HITCHING UP IS AN EASY JOB

In this type of hitch, the ball-and-socket coupler is clamped together by a removable block held with two pins and a spring clip

By
**EDWIN
TEALE**



To get first-hand information on trailer travel for our readers, the author made a 4,671-mile trip in a "home on wheels." In this article, the first of a series, he tells how he selected his trailer and answers many questions commonly asked. Watch for another installment next month

FIVE WEEKS on the gypsy trail; 4,671 miles in a "rolling home"! That is the assignment I have just completed for the readers of **POPULAR SCIENCE MONTHLY**. To

gather first-hand information about the amazing spread of trailer travel, my wife and I have driven through a dozen states, visited scores of trailer camps, talked with hundreds of men, women, and children who follow the Romany road in modern comfort.

According to the latest estimates of the American Automobile Association, 1,000,000 people are living in trailers. William B. Stout, the noted aircraft designer, predicts that, three decades hence, fifty percent of the people in the United States will reside in houses on wheels. During 1936, approximately 150,000 new trailers began rolling over the highways and, at present, nearly 700 manufacturers are turning out stock and made-to-order models.

Hunters are using trailers as mobile lodges, grocers are turning them into stores on wheels, prospectors are living in them as they hunt for gold, movie actresses are employing them as dressing rooms on location. They are featured in cartoons, in advertisements, in the movies, and on the radio. During the last New York automobile show, 1,200 persons an hour visited a single trailer exhibit. The house on wheels has come to the fore with a rush. And many people believe it has come to stay.

During our wanderings, we encountered bankers, farmers, fortune tellers, acrobats, surveyors, book salesmen, school teachers, evangelists,—all traveling in trailers and all enthusiastic about the life of a motor nomad. We saw trailers with awnings, trailers with porches, trailers with mountain scenes and waterfalls painted on the sides. We even met a bicyclist pedaling down a highway with a midget trailer trundling along behind!

At one camp, we found a wealthy woman who had partitioned off a special room in her trailer for her colored maid. At another, we just missed a veritable Noah's ark, a carnival trailer holding two grown-ups, two children, a police dog, a litter of puppies, and a lion cub! While we were on our trip, trailers from all over the country were rolling south. One evening, just at dusk, we pulled into a small camp in Florida and found five settled down for the night. One had come from Iowa, another from Michigan, a third from New York, a fourth from Ohio, and a fifth from Canada!

Most of the people with whom we talked were living on from twelve to fifteen dollars a week. Rent at a trailer camp,

in a Trailer

including electricity, laundry facilities, and shower baths, runs from sixty-five cents a night to \$1.35 a week. We heard of one family of five that started a trip with thirty-five dollars to cover all expenses except gasoline and oil. They traveled 15,000 miles, crossed seven mountain ranges, and reached home with seventy-five cents still in the treasury!

But let's start at the beginning. When we commenced planning our trip, all we knew about trailer life was that it must be fun. For weeks, we pored over catalogues, talked to salesmen, interviewed people who had lived in trailers. We discussed the relative merits of Covered Wagons, Kozy Coaches, Vagabonds, Nomads, Zephyrs, Auto Cruisers, Travelodges, Silvermoons, Mayflowers, Travel Mansions, and Tally-Hos. We began speaking a language that none of our neighbors understood. We talked of parking legs, hitches, landing wheels, electric brakes, knee-action axles. We made large, middle-size, and small lists of "things to take." We littered the table with maps, and read prospectuses that grew lyrical at the possibilities: "Visits to enchanted lands. . . . Freedom from cares and worries. . . . A silvery moon shining above, or a world of wonder passing by your window!" We were ready for trailer life. All we needed was the trailer.

There are three ways, we discovered, of getting one. You can buy plans and parts and build it yourself. Or, you can purchase a factory model, paying cash or buying it on the installment plan. Or, you can rent a trailer at so much a week. The rental rates range from thirty-five to fifty dollars, according to the size of the trailer. Usually, reductions are made for periods of a month or more. The agency supplies the license for the trailer. Sometimes, an additional fee of from ten to twenty dollars is charged for installing the hitch which attaches the trailer to the car. In almost all cases, the full amount paid in rent can be applied as part of the purchase price of the trailer if you desire to buy it after you have tried it out.

We found an infinite variety of trailers on the market. There are two-wheelers, three-wheelers, four-wheelers. They run the gamut from a \$300 streamline "pup tent," only a few feet long, to \$5,000 "road yachts," thirty feet long and weighing 7,000 pounds. It is possible to get trailers with hot and cold running water, with vanity dressers, with water-closets, with telephones connecting trailer and tow-



Interior of an up-to-date luxury trailer. The vanity dresser is a recent innovation



The author's caravan in a typical southern setting. Miles of scenery like this roll past the windows of the trailer



"Letting her out" over the sands of Daytona Beach, Fla., where Sir Malcolm Campbell hung up his world's record



"Tin-can tourists" playing shuffleboard at the large municipal trailer camp in Dade City, Fla.



This picture shows how the caster-type wheel is adjusted for height when the car is detached. A hand crank raises and lowers the wheel

ing car, with oil-burning heaters and gas stoves, with air-conditioning and hot-water-heating systems. Some are equipped with two-way radios, with electric refrigerators, with batteries charged by midget windmills on the roof. One even has a fireplace!

So many are the innovations and accessories designed for trailer use that at a recent convention of the Tin-Can Tourists, the national trailer organization, at Sarasota, Fla., a huge Ringling Brothers circus tent had to be borrowed to house all the exhibits. Some of the latest gadgets are folding steps, chemically treated garbage containers, and miniature electric washing machines.

Born of the depression, the trailer boom has spread to all corners of the country. It is keeping factories humming and inventors busy. Trailer enthusiasts now have their own magazine and, besides the Tin-Can Tourists, there is another organization, the A.T.A., or Automobile Tourist's Association. Makers of equipment recently formed the National Coach Trailer Manufacturers' Association. Summer conventions in the north, and winter conventions in the south, attract thousands of members of these three groups. During one gathering in Florida, 500 trailers pulled into camp on a single day.

In the end, after considerable shopping

around, we rented a \$1,000 de luxe trailer from an agency near New York. Our home on wheels was nineteen feet long, six feet three inches wide and seven feet nine inches high. It was trimmed in red and silver. The headroom inside was six feet two inches. It contained an ice box, a toilet, a heating stove, a gasoline cooking stove, beds for four people, cupboards for dishes,

closets for clothes, drawers for food and incidentals. Each drawer, we found, was notched so it locked itself automatically when pushed into place. This kept it from sliding out when the trailer struck a rough road or a sharp curve. To open a drawer, you lifted before you pulled. Two kinds of lights illuminated the interior. Dome lights ran on current from the automobile battery, while regular lamps, operating on 110-volt current, were used in camps where electric connections were available. At the enameled sink, a pump drew water from a twenty-gallon storage tank beneath. The beds, as comfortable as you would find in any hotel, made up into seats for daytime use. Complete, the trailer tipped the scales at 2,100 pounds. It rolled along on two large, punctureproof "doughnut" tires.

For five weeks, the rent was \$200. In addition, we made a deposit of twenty-five dollars to cover possible minor damages to the trailer while it was in our possession. At the end of the trip, we received twenty dollars back. Five dollars was deducted for a chimney cap which disappeared somewhere along the route and for photographic-developer stains in the bathroom.

Monday morning, we left the car to have the hitch installed. Late Wednesday afternoon, the dealer drove up the street, with a crowd of children trooping

behind, and stopped in front of the house. My heart sank. The trailer looked as big as a mountain. Could I ever maneuver it through traffic?

That I have discovered from questions asked me by friends since my return, is the first thing every beginner wonders. Half a dozen other questions always come out in the course of a conversation, so I will answer them here. The interrogation usually runs about like this:

Q. How about steering? Is it harder with the trailer attached?

A. No. You take wider turns, and you can't cut in as soon after passing a car, but otherwise there is little difference. One thing you may notice at first is a slight pull from suction every time you meet a car speeding in the opposite direction.

Q. Does it take longer to stop when you put on the brakes?

A. As a matter of fact, you stop quicker, because the trailer has powerful brakes of its own.

Q. Do you *(Continued on page 121)*



Drawers are notched on the bottoms, as indicated by the pencil, to prevent opening on rough roads

Microscopic Ranch

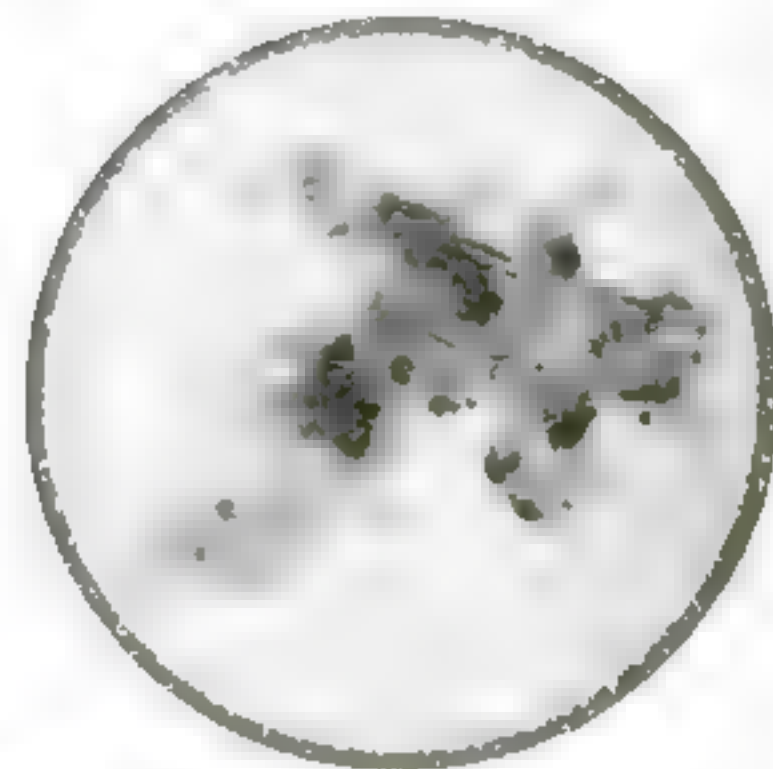
RAISES TINY ANIMALS
FOR THE LABORATORY



L. D. Martin, one of the proprietors of the unusual business, collecting hydras at an outdoor pool. The water used is specially suited for protozoan culture



This is a hydra as it appears through a microscope lens



And this is an amoeba. Millions of them are sold for student use

WITH finger bowls for grazing ranges, one of the strangest stock farms on earth, near Elon College, N. C., produces millions of microscopic animals every year for use in biology classes in schools from coast to coast. Two former Elon professors, Dr. T. E. Powell and L. D. Martin, have operated the protozoan ranch for more than ten years. They started in 1926 in a shed purchased from a shoemaker. Since then, they have expanded until today they have a complete biological supply house, with 135 acres of land and a main building 200 feet long. Natural springs, flowing from beds of disintegrated granite, supply the water for the cultures. This water appears to make the animalcules grow larger, keep cleaner, and stand shipment better. As many as 1,000 heavy glass finger bowls, each holding a separate culture of amoebas, are sometimes stacked on tables in a room kept at a constant temperature of from sixty-eight to seventy degrees F. by thermostatic control. The "round-up" is accomplished with medicine droppers, the amoebas being sucked from the bottoms of the finger bowls and packed in containers in varying quantities. Hydras, another common kind of protozoan, are raised in outdoor ponds.



Dr. T. E. Powell at work in the amoeba room, where as many as 1,000 finger bowls provide grazing ranges for the minute animals. They grow to salable size in three to six weeks



The great "round-up": at the left, amoebas are being collected from a bowl for shipment. Above, using a medicine dropper to suck hydras from the underside of a lily leaf

Magic Molding Material

FINDS USES IN SCIENCE, ART, AND INDUSTRY

CAUGHT in the whirling teeth of a machine, the hand of a workman was badly injured in a Chicago factory a few months ago. The machinist was rushed to the hospital for treatment, and a claim was put in for accident insurance.

Three days later, a clerk in a New York insurance office unwrapped a package mailed from Chicago. Out dropped a hand with three fingers missing and an ugly scar across the palm. With this as proof of injury, the insurance was paid, and the hand was stored away for future reference.

The hand, however, was not made of flesh and bone, but of an amazing substance known as moulage—a waxlike modeling preparation with which even an untrained user can make a realistic duplicate of a finger, a face, a lizard, a potato, or a footprint. An ultramodern improvement over wax and plaster of Paris, it remained virtually unknown until scientific detectives found it an ideal medium for preserving perishable clues. Today, anyone can buy and use moulage; and amateurs, professionals, hobbyists, and scientists are daily discovering new and novel applications for the versatile material.

Moulage has even found its way into the kits of explorers. Traveling through far-away Irak in Asia Minor, not long ago, a noted archaeologist came upon an unusual set of rock carvings adorning the façade of a ruined temple. To take the wall apart and bring it home was impossible, so he did the next-best thing. He photographed it, and then, section by section, made a moulage cast of the intricate stonework, tinted it to imitate the color of the actual stone, and shipped it to the United States.

At about the same time, scientists at the American Museum of Natural History in New York City were faced with the problem of mounting a giant skull on a dinosaur skeleton. Filled with solid rock and weighing more than two tons, it was too heavy to be suspended in mid-air. Experts solved the problem by preparing a lightweight duplicate in moulage to be

By **ROBERT E. MARTIN**

attached to the long neck of the mammoth exhibit. The actual skull, stored in a near-by cabinet, is now on display for those who wish to examine it.

Moulage takes its name from the French word for "molding." Its inventor, Dr. Alphonse Poller of Vienna, Austria, developed it primarily for making intricate casts of portions of the human body to serve as models for his classes in anatomy. In this country, however, moulage made its debut as an aid in fighting crooks. First introduced at the Scientific Crime Laboratory of Northwestern University, a few years ago, it is employed today by virtually every first-class police department. Victims of hit-and-run drivers and of gang violence have been identified, long after burial, by means of moulage death masks. Footprints in the mud, jimmy marks on window sash, automobile-tire tracks, and even tooth marks in a half-eaten apple have been preserved in moulage and used in solving baffling crimes.

One of the strangest police uses of moulage followed the recent discovery of the legs of a woman, severed from the body, in Boston harbor. Since the head and torso could not be found, the identity of the victim was a mystery. Making the most of their slender clue, the Boston police took casts in moulage of the legs and feet. Then, in a grim sort of Cinderella test, they tried fitting the moulage feet to the shoes of girls known to be missing. Their search ended in a home near Boston, where shoes that matched the casts

exactly, identified the woman.

In a recent manslaughter case reported from Los Angeles, Calif., a moulage cast helped to convict a hit-and-run driver. A broken fragment from the tip of an automobile bumper was the only evidence found at the spot where the victim had been killed. From this piece, police made a moulage cast, duplicating the end of the bumper that they believed remained on the car. A check-up of all cars with damaged bumpers led to a machine with one that matched the cast. Confronted with the evidence, the guilty driver confessed and was sentenced.

More in line with the original application of moulage—making anatomical models for medical purposes—are some of its current uses in the hands of doctors and surgeons.

When an elderly woman in a small western town broke her leg, not long ago, her doctor found that she needed a brace of an unusual type. There was only one place to secure it—from an eastern firm that specialized in such devices. The doctor

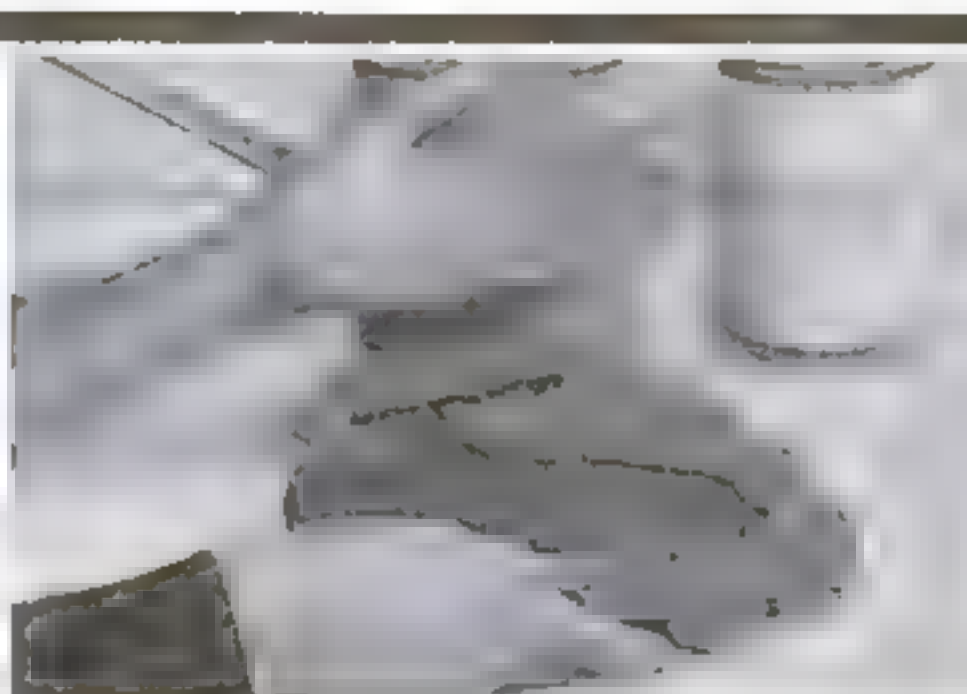
An art student applying moulage to a small statuette in preparation for making a copy of it



1 The first step in making a cast of a hand is to apply the "negative" moulage to it



2 When the mold is complete, it is turned over, as shown, and is ready to be removed



3 This photograph shows the hollow mold before the application of "positive" moulage

In making a mask of the face, the "negative" moulage is first spread on, as below. The picture at the right shows the face completely covered and a wire frame in place to support the delicate mold as it hardens



In the circle, the mold has been removed from the face and "positive" moulage is being poured into it. Above is the completed mask for comparison with the original

sought aid from the local police department, which used moulage. A cast of the broken leg was made with the material, and shipped east, where the supply firm fitted a perfect brace.

Orthopedists often encounter cases in which patients must have shoes made to order by a distant firm, but lack the time or money for the trip. The problem is solved by making a moulage cast of the foot and shipping it to the shoe manufacturer.

Eye specialists also are taking advantage of moulage for the ticklish task of fitting the new-style invisible or "contact" eyeglasses—tiny curved disks of glass that rest directly on the eyeball. To guard against twitching and discomfort to the patient, they first apply a desensitizing solution to the eye. The warm moulage is then poured directly over the eyeball. A cast from the resulting mold enables an expert to insure a comfortable fit for the lens.

The same advantages that moulage exhibits in specialized uses like these make it an all-around modeling aid of practically universal application. So simple is it to apply that school children are using it. Flexible and resilient even after it has cooled, the waxlike material gives to per-

mit an object to be withdrawn from the mold, like a hand from a glove. Thus seamless, one-piece casts may be made of objects that would have to be cast in sections with other modeling materials. Since the final reproductions are not solid masses but thin shells, even large casts are not cumbersome in weight. When reinforced, they are virtually unbreakable.

FOR collectors and home craftsmen, moulage offers unlimited possibilities. One amateur, a Morrisville, Pa., nurseryman, makes a hobby of collecting mushrooms, toadstools, and other fungous growths. Last summer, during a trip through New England, he made moulage casts of specimens he found. The novel collection proved so interesting that it recently was placed on exhibition in the Franklin Institute of Science at Philadelphia. Anyone who has ever examined the intricate markings on the underside of a toadstool knows how delicate they are, yet the moulage casts reproduced them accurately.

Most fascinating of all the amateur diversions that moulage provides, however,

is home sculpture. Heretofore, only the well-to-do could afford to have masks or busts made. Now you can make likenesses of yourself, your relatives, and your friends, at small cost and by a simple method.

How this is done offers a good illustration of the technique of using moulage. The dealer supplies the material in three slightly different forms. You use the first to make a "negative" or reverse mold, brush the second into it to obtain a "positive" reproduction, and reinforce the thin cast that results with a layer of the third.

When you are ready to make a life mask from a living subject, your first step is to liquefy the pink "negative" material by heating it gently with water. At a temperature low enough to cause no discomfort to the skin, it takes on a creamy consistency and may be brushed right over the face. No greasing, oiling, or other preparation is needed, for moulage does not stick to the skin, or even to the hair. A cardboard mask with an oval hole, cut to fit the subject's head, serves as a base for the mask (*Continued on page 126*)



4 The "positive" is built up in successive layers. It is tinted to match color of skin



5 After hardening, the thin, flexible shell of the cast is easily removed from the mold



6 Filled with a reinforcing substance, the finished hand is a lifelike reproduction

COLORED CHARTS TEACH HISTORY



Lithographed historical charts for reference use in school or library



A teacher showing a pupil how to tint related historical events on a black-and-white chart

WITH a novel educational game just marketed, children learn history by coloring scientifically prepared charts. Detailed outlines of the major events in political, scientific, and artistic history are printed in black on white paper. As the pupils study the charts, they paint panels recording individual events with transparent colors. Thus, in a section on science, mechanical inventions are tinted light blue, electrical discoveries dark blue, railways red, ships orange, and historic buildings green. The originators claim that students thereby obtain a correlated impression of the main facts in world history.

AIRPORT TRANSMITTER HAS SQUIRREL-CAGE ANTENNA

RESEMBLING a small Ferris wheel, a novel directional antenna has just been installed at a California airport as part of a new short-wave transmitter now operated by a major air line. The "squirrel-cage" loop aerial was specially constructed for transmitting instructions and weather data, and is said to assure clear phone contacts between the airport and far-distant planes.

ELECTRIC DEVICE SCORES FENCING BOUTS



A fencer being "plugged into" the circuit which causes a light to flash when a touch is made. In oval, a demonstration of the device, seen at right

FENCING BOUTS are scored automatically by a novel electrical apparatus used in a recent tournament in New York City. Each fencer is connected to an open electrical circuit by means of wires trailing from his waist; whenever a blade touches a contestant, the circuit closes and the "hit" is scored on a recording instrument mounted on the wall. Spring-operated reels, which are part of the device, keep the connecting wires taut to prevent their entangling the fencers' feet.



BASKET CANE IS CARRIAGE FOR KITTENS



ENSCONCED in feline rumble seats attached to a walking stick, three pet kittens belonging to an English girl are taken out for their daily airing in the novel manner shown in the photograph at the left. The kittens placidly view the passing scene from wicker baskets strapped to cross supports mounted on the stick, which is hooked over the owner's arm.

RUBBER TAIL LAMPS

TAIL LIGHTS for automobiles are now being encased in rubber to prevent breakage. The flexible rubber fixtures are said to absorb road shock and car vibration, thus contributing to the longer life of the bulb. In case of an accident or collision, new lenses may be installed.

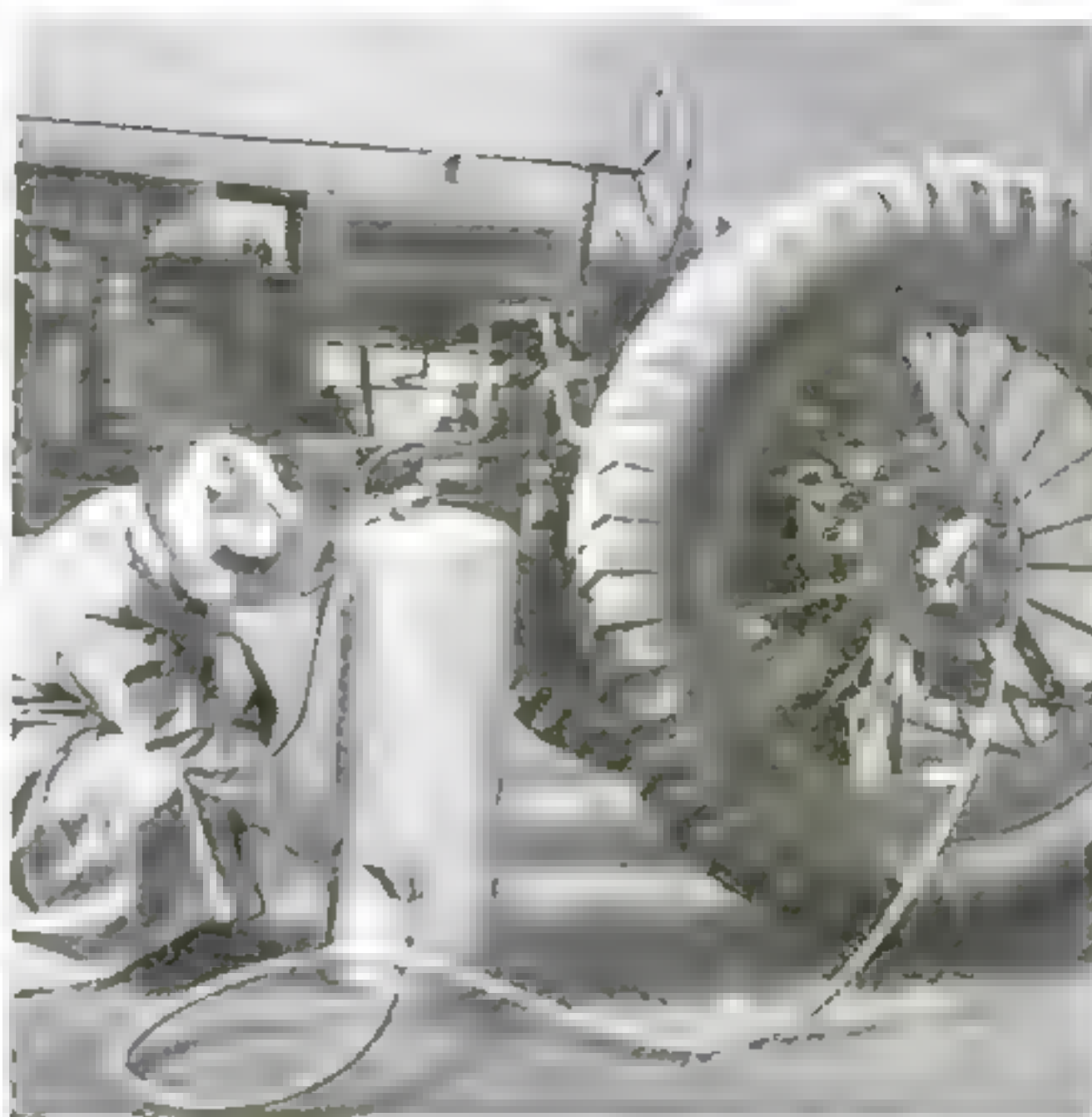
TRACTOR TIRES FILLED WITH WATER



This remarkable photo shows the jumper in mid-air

'CHUTE JUMPER LIGHTS CIGARETTE IN PLUNGE

WHILE rocketing earthward in a delayed-opening jump from an altitude of 5,000 feet, Harold Parkhurst, dare-devil parachute expert, is shown in the photograph above nonchalantly lighting a cigarette with a windproof lighter. The unusual shot of this exhibition of steady nerves was snapped from a plane.



Left, forcing water into tractor tires with a pressure tank to add weight for traction. Above, adding calcium chloride to the water as antifreeze.

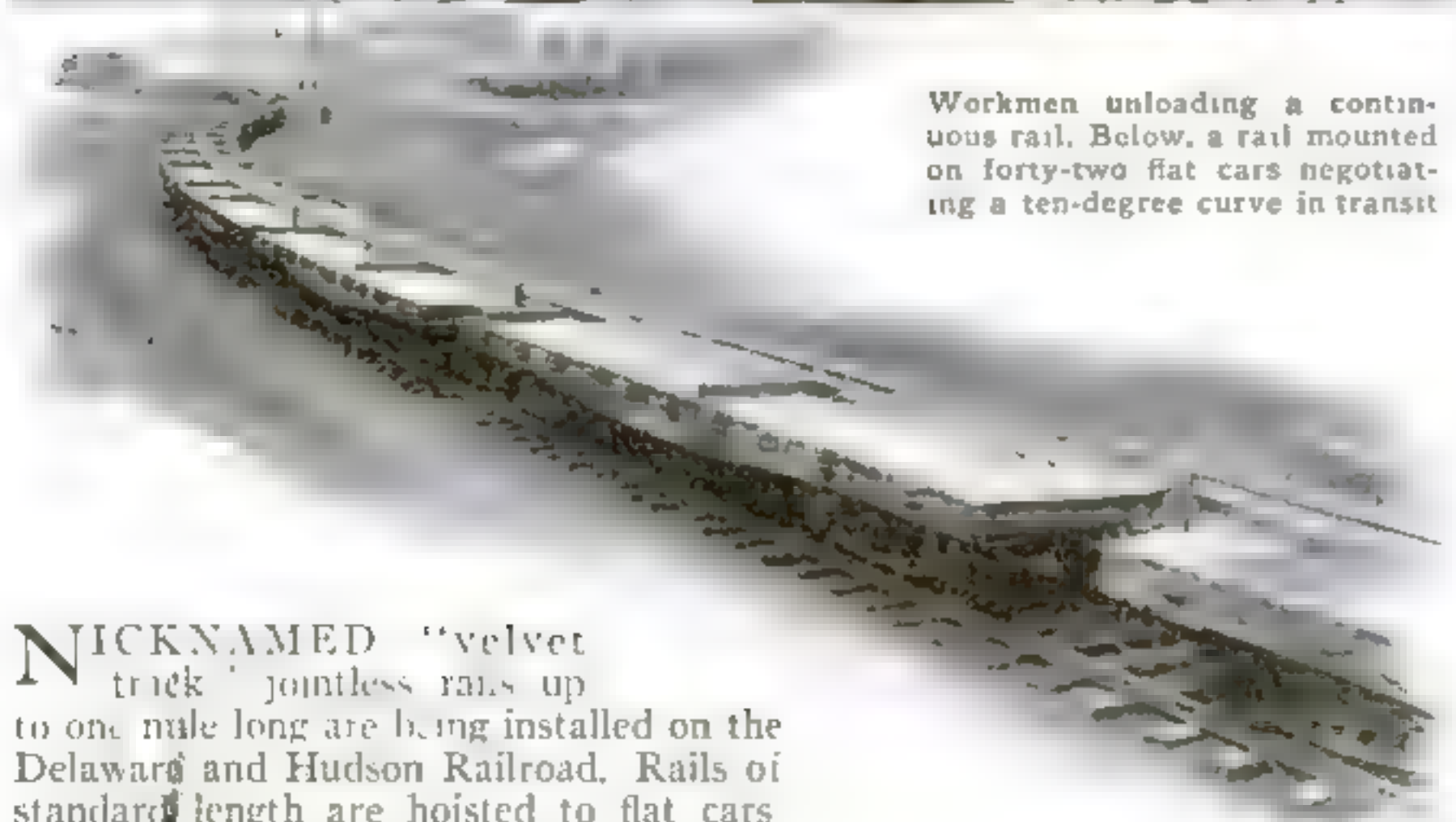
TO PREVENT tractor tires from bouncing on rough ground and thus losing pulling power, water is now being used to fill the giant inner tubes. One end of a special metal socket is fitted to the tire valve and the other end to a garden hose. Jacked off the ground, the tire is

filled with the desired weight of water, after which air is pumped in to the usual pressure. Where water pressure is not available, an inexpensive pressure tank is used. The liquid is said to provide normal cushioning without objectionable rebound or bouncing on the roughest ground.

JOINTLESS RAILS MAKE "VELVET TRACK"



Workmen unloading a continuous rail. Below, a rail mounted on forty-two flat cars negotiating a ten-degree curve in transit.



NICKNAMED "velvet track," jointless rails up to one mile long are being installed on the Delaware and Hudson Railroad. Rails of standard length are hoisted to flat cars, welded at the joints into a single continuous strip, and hauled to their destination, where they are eased onto the ties as shown in the photograph above. Special metal tie plates clamp the mile-long rails to the ties so firmly that longitudinal expansion and contraction due to temperature changes are practically eliminated.

Besides providing an ultrasmooth ride for passenger trains, the continuous rails are expected to save expense now incurred in surfacing and maintaining track containing conventional rail joints.



FLOODPROOF DOORS GUARD NEWSPAPER PRESS ROOM

TO FORESTALL the possibility of river floods inundating its press room and preventing publication, a Pittsburgh, Pa., newspaper recently installed mammoth steel shutters over ground-floor doorways at its printing plant. Made from watertight metal strips, the barriers slide up and down tracks fastened to the brick walls of the building. When not needed, they are rolled up compactly into rectangular cabinets at the top of the doorways. The photograph shows a door being installed.



FIELD TELEPHONES AID GOLF TOURNAMENT

TO FACILITATE the handling of a recent golf tournament at a Los Angeles, Calif., municipal course, officials installed a complete army-type field-telephone system. Attached to trees at strategic points along the course, the phone installations permitted the tournament managers to schedule starting times correctly, to follow the progress of each player, and to obtain scores at the earliest possible moment. Operators stationed at portable switchboards routed the calls.

MOVIES MAKE DRY FOG FROM DRY ICE

RESEMBLING a Dutch oven combined with a blower, a machine devised by William Middlestadt, Hollywood technician, produces a dry fog to replace the sulphur smoke and the moist vaporized oils now in general use on movie sets. Compressed air blowing over dry ice creates a white mist above the set; being heavier than air, the fog gradually settles to the floor. In the photograph, the inventor is explaining the device to Freddie Bartholomew, boy star.



The inventor explaining his device for making dry fog for movie scenes



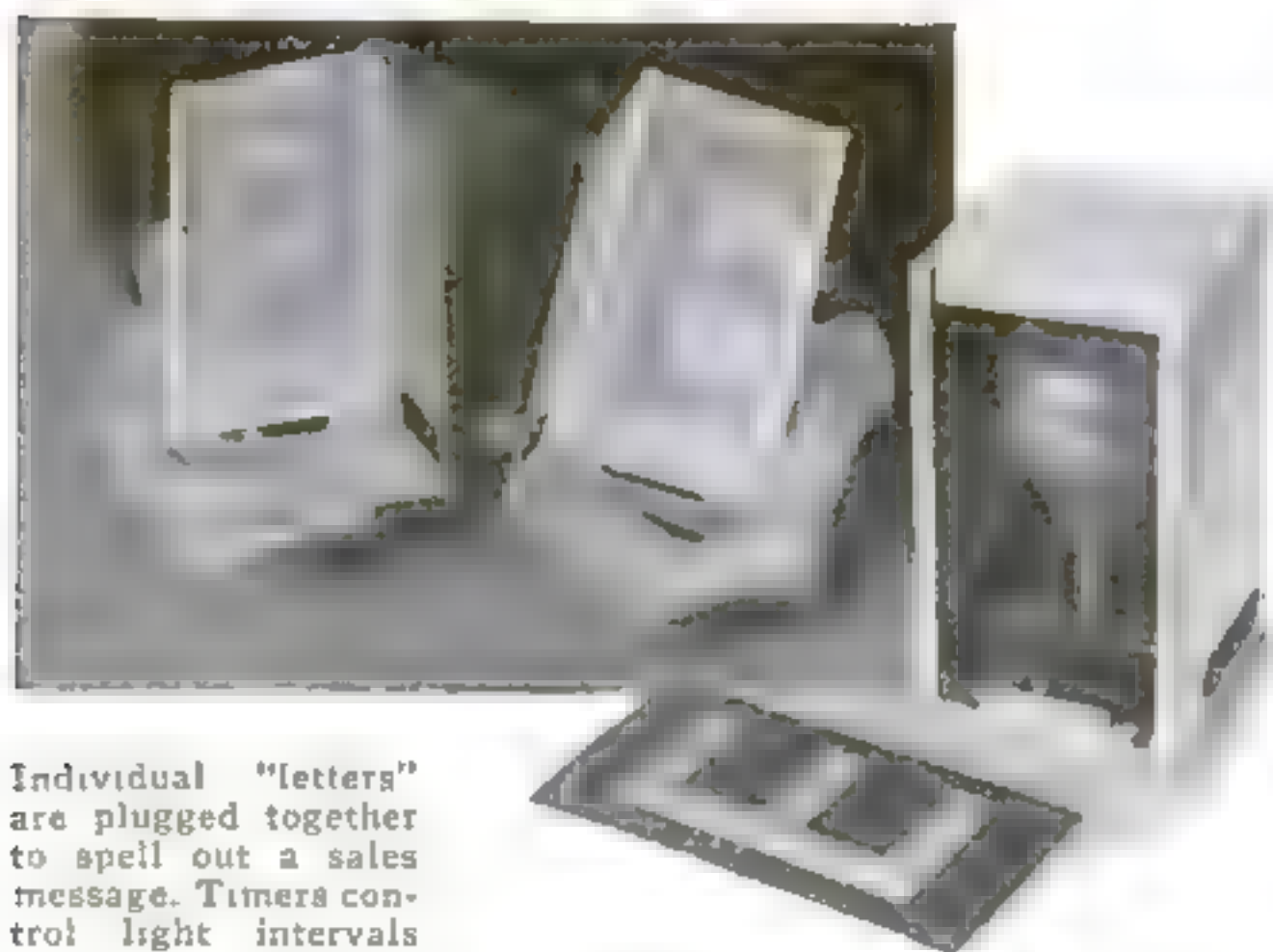
Postage stamps of many colors form this picture

ODD PICTURES "PAINTED" WITH POSTAGE STAMPS

USING postage stamps of many nations as his material, Marc Drouin, French philatelist, fashioned the unique picture shown at the left. Delicate color shadings were achieved by the discriminating use of stamps of many hues. Exhibited recently in a Paris art gallery, three such stamp pictures are said to have required 750 hours to make.

RIVER-BED POWER PLANT

BECAUSE spring ice jams and heavy rains might damage any building erected on the banks of the Persante River in Germany, a hydroelectric power plant has been constructed so that it is entirely under water. Set solidly on the river bed, it is reached by subterranean tunnels. Ice and debris pass over its top.



Individual "letters" are plugged together to spell out a sales message. Timers control light intervals

LETTER UNITS FORM ELECTRIC SIGN

CONSISTING of interchangeable units that resemble children's blocks, a novel electric advertising sign developed in Germany spells out its message letter by letter. Box-shaped units, each containing an electric bulb and covered by a removable lid bearing a translucent letter, are plugged together to form words, while individual timing devices control lighting intervals.

TRAILER HAS CLOSETS IN SHOWER DOOR

BROOM CLOSET, wardrobe cabinet, and shower stall are combined in one small unit in a new trailer. Opening a small door reveals a space for brooms and mops, while a larger door in which it is set opens into the clothes compartment. The latter, in turn, swings back to reveal a convenient tiled shower. The clothes closet also is accessible to a person in the shower, as shown in the photo at the right. The compact arrangement results in a considerable saving of space in the design of a trailer.



The clothes closet is built into the shower door



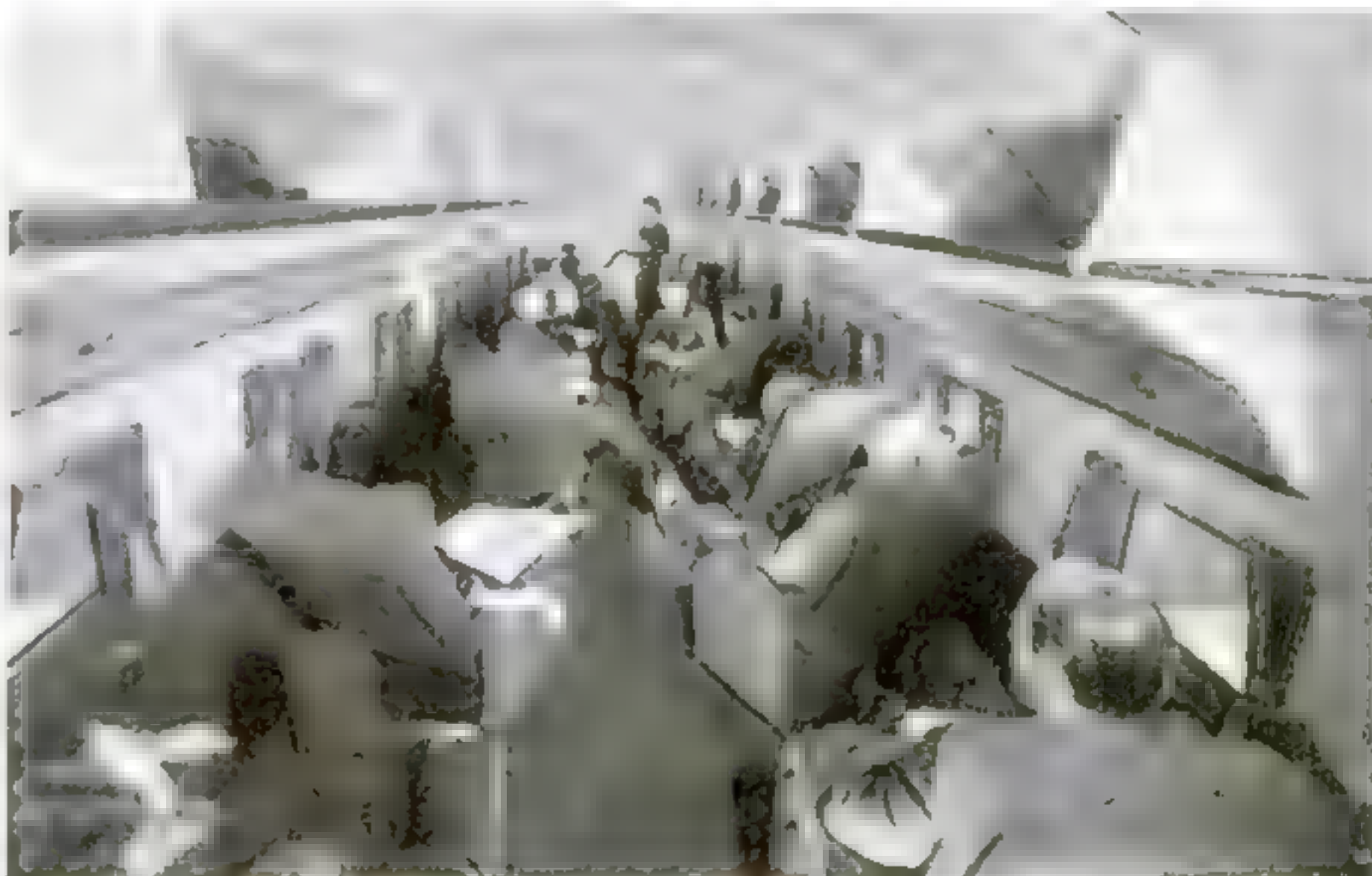
AMPLIFIER UNIT IN LAMP SERVES AS HEARING AID

INSTALLED in the decorative base of a table lamp, a novel microphone-and-amplifier unit is a new aid to persons who are hard of hearing. Sounds in a room are picked up by a cleverly disguised parabolic reflector and directed into a hidden microphone wired to a built-in, all-electric amplifier. A bone-conduction-type hearing aid plugged into the base of the lamp transmits the amplified sounds to the user.

PLANE RIDERS GET LOUNGE CHAIRS

DESIGNED for a three-stop, coast-to-coast schedule, a new transport plane just placed in service rivals the luxury and comfort features of railroad chair cars. Fourteen deep-cushioned chairs, attached to swivel bases, are mounted in the roomy,

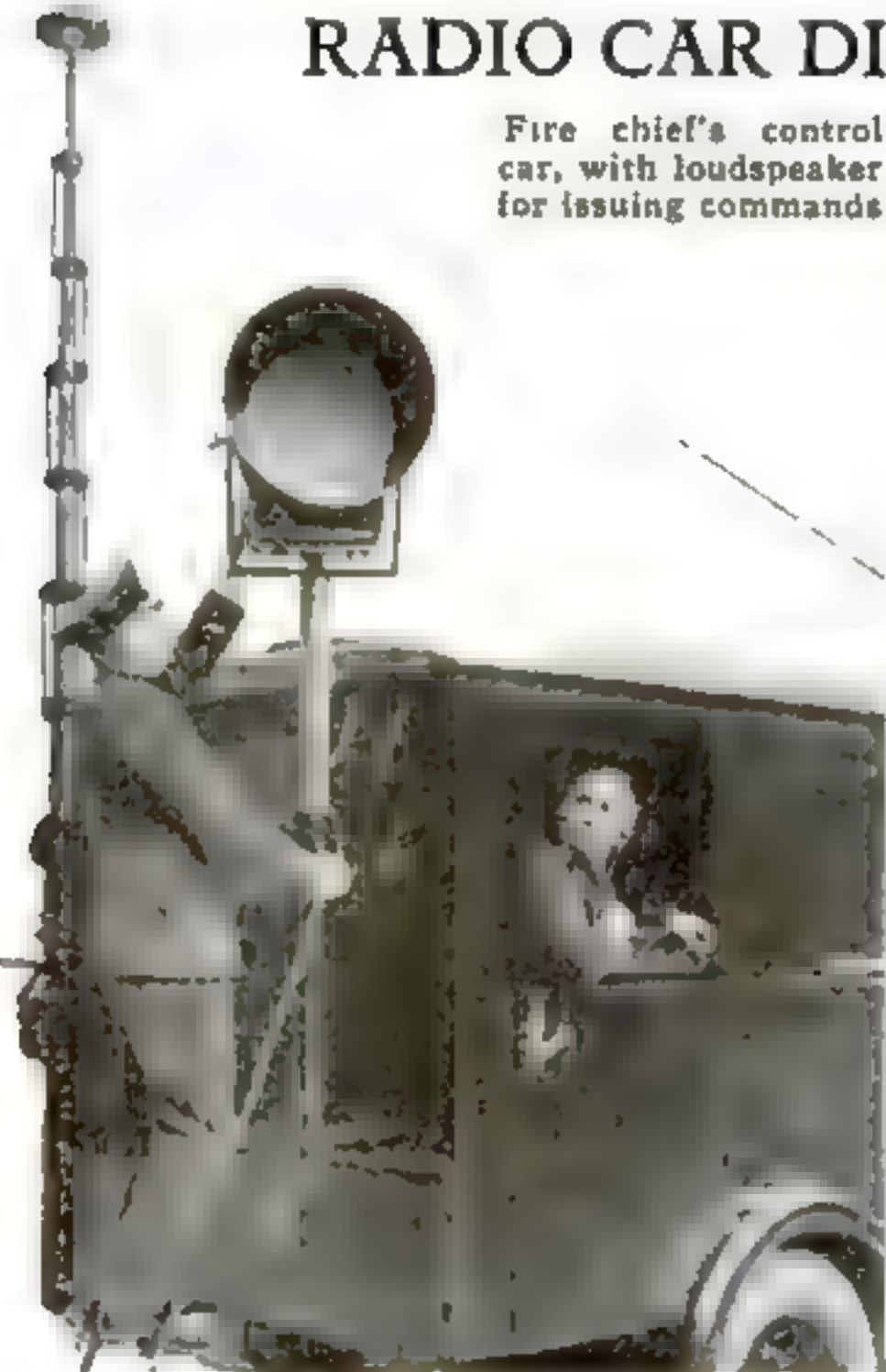
sound-insulated cabin, which would accommodate twenty-one seats of the type customarily used in passenger planes. Other features include air conditioning, steam heat, and an intra-plane telephone service. Hot meals will be served with china, silver tableware, and linen.



Cabin of a new transcontinental transport plane, fitted with comfortable swivel chairs

RADIO CAR DIRECTS FIRE FIGHTERS

Fire chief's control car, with loudspeaker for issuing commands



SHORT-WAVE radio now aids firemen in fighting major conflagrations in Berlin, Germany. From a new control car which is driven to the scene of a blaze, the fire chief directs the operations of his men through a loudspeaker unit, while he keeps in constant touch with central headquarters by means of a two-way short-wave set. Thus no time is lost in securing additional fire-fighting units as soon as they are needed, or in dispatching idle apparatus and equipment to other fires that might break out in different sections of the city.

SHAVING CREAM KEEPS RAZOR BLADES SHARP

RAZOR BLADES will stay sharp from fifty to 200 percent longer if used with a shaving cream containing a little potassium chromate, according to a Texas chemist. Without irritating the face, the chemical is said to retard the rusting of the fine edge of the blade, which is the principal cause of blades becoming dull.



WISE COMES OFF BASE FOR USE WITH DRILL

MOUNTED on a swivel base which is attached to a workbench, a new vise is a handy addition to the home workshop. Without disturbing the work held in the vise, the new implement can be detached from its base for use with a drill press or other workshop machine. Accurately finished so that it may be used on either its side or end, as well as on the base, the vise is supplied with a grooved block of hardened steel for use in holding round stock. In the photo above, the vise has been removed from its base, which can be seen on the bench in the background, and is held to the faceplate of a drill press by means of a special vise clamp while threads are being tapped.

CELLULOID HOOD FITS BABY BUGGY

TO PROTECT her child from wind and rain, an English mother recently devised the auxiliary baby-carriage hood shown in the picture at the right. Transparent celluloid sides and top are mounted on a wooden, box-shaped frame which slides into grooves built into the perambulator body. The child can thus see out, while fully protected from inclement weather.



Inside this shield, a baby is protected from wind and rain

Better Farm Animals



PROMISED BY NEW TESTS

• •

Dr. Max Kleiber and an assistant getting a cow ready for a test in the "psychrometric room" at the University of California College of Agriculture. Under controlled climatic conditions, all the vital functions of the animal can be studied. The apparatus below even analyzes the cow's breath

By STERLING GLEASON

IMAGINE a row of cross-eyed cows looking out from their stalls in a long dairy barn, peacefully chewing their cuds while expert "nurses" feed them special rations planned by laboratory dietitians, and care for them as if they were members of a royal family.

That is one of the strange sights you would see if you were to visit the University of California College of Agriculture at Davis, Calif., where scientists are striving to produce laboratory-bred, "standardized" animals so true to type that whole families will be as nearly alike as automobiles from a factory production line. They want cows that give milk generously; steers that produce finer, more tender beef; sheep heavily coated with superior wool; lambs built to make choice loins and chops; pigs that give firm, tasty bacons and hams well proportioned between fat and lean. In short, they want to cut the wastes caused by nature's mistakes and give us better foods for our tables at lower cost.

The weird-looking, cross-eyed cows are one set of answers to a problem upon which California scientists have been working for nearly twenty-five years. They represent a freak characteristic, known as a latent or "recessive" defect, long hidden in the blood of pedigreed animals and now for the first time intentionally brought to the surface so that it can be eliminated.

At the California experimental farm, Prof. William Regan has been deliberately



Against this screen, the physical qualities of a sheep can be checked

inbreeding cattle, or mating sires with their daughters, in order to bring these latent defects to light, thus making it possible to weed out animals bearing defective strains, and to develop a superior, untainted stock. Queer specimens are produced by these experiments: cross-eyed cows, hairless calves, bow-legged animals, and hideous creatures with enormous heads and weird faces that resemble those of English bulldogs.

These mistakes of nature are ruthlessly discarded from the breeding stock, and, to the great satisfaction of the experimenters, the milk production of the test herd has been steadily rising. At the beginning, the average butter-fat production of the herd was 545 pounds a year; today it is 580 pounds.

Eventually, out of all these scores of

animals will emerge one that passes all the tests, and a pure, faultless line can be started. This will stem from a super-cow—a blue-blooded animal which will give abundant milk, rate high as beef, and breed offspring that will have the same superior qualities.

Most interesting, perhaps, of all places in the huge California labora-

tories is the "psychrometric room," where cows and other animals undergo strange tests. In a small chamber, double-walled and heat-insulated, a cow is placed for observation, while the stall is regulated to any desired combination of temperature and humidity to give artificial climates ranging from that of a high mountain peak to that of the hottest desert. Air at a fixed temperature is supplied through a rubber nosepiece. A little coaxing, and a bit of experimentation of her own, soon convince the cow that she is most comfortable when breathing through this intake.

Every breath exhaled by the animal under test is collected by giant air pumps and drawn into apparatus where it is weighed and broken down into its constituents. Bubbles rise through long glass

tubes full of liquid; batteries of narrow-stemmed flasks, filled with purple fluid, are rocked back and forth by mechanical hands; huge copper cylinders lazily rise and fall, in a mechanized chemical laboratory where almost every step in a long and tedious routine is performed automatically. An animal placed in the psychrometric chamber may have almost any bodily process measured, from the air it breathes to the efficiency of its digestive organs.

In one of the countless experiments made possible by this apparatus, the question was: Is a cow's rate of breathing controlled by the temperature of the air on her skin, or the temperature of the air reaching her lungs? By supplying the animal with cool air while the chamber itself was warm, and then reversing the situation, experimenters learned that the creature's skin acts as a sensitive indicator which controls the action of the lungs.

One of the most remarkable freaks at the laboratory is a cow equipped with a window in her side, left by an operation to remove an abnormal growth. Through a light-and-mirror device, almost anything that goes on inside the cow's body can be watched by the experts without pain to the animal. Farmers know, for instance that too much green alfalfa will make a

cow bloat up like a balloon. Once, when this freak animal overindulged in alfalfa, her digestive canal swelled up with gas; experimenters promptly hooked up apparatus and accurately measured the pressure, much as one tests a tire with an air gauge!

Problems of heredity are being studied by Dr. P. W. Gregory, who is striving to learn what governs the inheritance of size. Prof. R. F. Miller is working on long-time experiments to improve the quality of spring lambs by crossbreeding, while Prof. E. H. Hughes is seeking to "standardize" pig production by inbreeding hogs in the same way that Professor Regan is experimenting with cows.

Meanwhile, other experts at the University have been working to spread knowledge of their findings. Thirty-five prize bulls are out on loan to progressive farmers throughout the state, so that the blood of these superior animals may filter into the cow "population" and raise the standard of the whole. One California dairyman began eight years ago to bring the blood of these animals into his herd. Now, eighteen of his cows produce as much milk

as thirty of those in his original group.

The work of the Davis "clinic" received spectacular demonstration when the latest census figures were released by the Government. A decade before, the 1920 census had revealed a deplorable condition in the dairy industry. The average California cow was producing 182 pounds of butter fat a year—forty pounds more than the national average, but still not enough to make dairying a sound business. Further pencil work by farm advisers showed that the cows should yield at least fifty percent more. But how to persuade the cows?

Up in a northern county of the state, a little association of dairymen brought out data showing that half their herds actually were averaging 265 pounds of butter fat a year. If these cows could yield so generously, why couldn't others?

At a dairy show that year, directors of the University's extension service announced that they were going to try, with the aid of farmers, to raise the California average to 265 pounds a year within ten years. The census figures of 1930 were to tell the tale. (Continued on page 125)

Below, an experimenter is placing a pair of rabbits in a test chamber in which artificial climates ranging from desert heat to mountain cold are easily produced



A beef-cattle herd sire bred at the California experimental farm. His blood is helping to raise the standards of western beef cattle



To measure the pulling power of draft horses, farm advisers invented this "horse dynamometer." Testing weights are mounted on the body of a truck

TRUCK IS MOBILE THEATER FOR OUTDOOR SOUND MOVIES

COMPLETE equipment for showing outdoor sound movies is contained in a novel truck recently designed by a New Jersey inventor. From a projection machine in the rear, the film image is reflected by inclined mirrors onto a translucent screen raised over the driving cab, as shown in the diagram at the right. The screen collapses into a rectangular case when not in use. A gasoline engine within the truck body generates electric current for operating lights, projector mechanism, and the twelve loudspeakers, six of which are placed on each side of the body. It is expected that the movie truck will be extensively used in political campaigns and for commercial publicity.



The mobile outdoor sound-movie theater in use. The sketch shows arrangement of projector, screen, and loudspeakers



PONTOONS TURN LAND PLANES INTO AMPHIBIANS

LAND PLANES become amphibians with the addition of lightweight pontoons just introduced. Retractable wheels in the front section of the floats are lowered for land

use, while rear pontoon compartments are joined to forward sections by hinges and shock absorbers so that they act as tail skids to brake the plane when landing.

CAMERA RECORDS A STRANGE DRAMA OF MARINE LIFE

IN THE remarkable photographs reproduced below, a sea anemone, one of the strangest and most brilliantly colored forms of underwater life, is shown making a meal of a small fish. The first picture shows the anemone with its tentacles spread open, and a fish nosing among them in search of food. As the fish grazes the

tentacles, the flowerlike sea animal shoots out a tangling web of poisonous, stinging threads that envelop its prey. In the right-hand photograph, the fish has been trapped and is being slowly drawn into the anemone's digestive sac as the tentacles bend inward like fingers that are slowly closing to form a fist.



Here an unsuspecting fish is nosing among the tentacles of a sea anemone. . . and here it is trapped. Near-by, another anemone has made a catch

TYPISTS' SPEEDOMETER GAUGES KEYBOARD SPEED

USING an electric typewriter, visitors to a recent exposition gauged their typing speed with the novel apparatus pictured below. Lights flashing on a glass strip indicated the number of words typed in the period recorded by a "stop-watch" clock.



An exposition visitor testing her typing speed

VIBRATIONS TEACH DEAF-MUTE CHILD



The vibrating machine may teach this deaf-and-dumb child to talk

BLIND, deaf, and dumb, four-year-old Joan Higgins of Chicago is learning to communicate with the outside world by means of an apparatus which vibrates in response to sounds spoken into a telephone mouthpiece. The child places her finger on a sensitive vibrator at the top of the instrument, so that when her instructor says the word "stand" and then helps her to her feet, she learns to associate the vibration with the act. It is hoped that she will learn to talk by associating the sounds she feels with one hand on the vibrator and the other on the speaker's throat, as shown in the photograph at the left.



PAPERS GET "RAINCOATS"

TO PREVENT newspapers from becoming water-soaked and torn in rainy weather, copies of the Oakland, Calif., "Tribune" are now wrapped in waxed paper before they are delivered to subscribers. On stormy days, newsboys roll each copy of the paper in a protective sheet before leaving it on an unprotected porch or doorsill.

ODD COSTUME IS MADE OF EYEGGLASS LENSES



Spectacular is the word for this gown and headdress made largely of eyeglass lenses

EXCEPT for a few supporting lengths of twine and fine wire, the odd costume shown in the photograph at the left is made entirely of glass. Designed by Dr. Lillian Grandmason, an optometrist of Los Angeles, Calif., the glass gown and headdress are composed of hundreds of high-quality eyeglass lenses. The dress, valued at \$1,000, was made for display at a recent exposition of optical equipment.

SHOW WORLD'S BIGGEST SHOE

WHAT is believed to be the largest shoe ever manufactured was a featured exhibit at a recent footwear manufacturers fair held in Chicago, Ill. In the photograph at the right, a young woman is demonstrating the size of the giant leather foot covering by using it as a carriage, "driving" it by means of the mammoth shoe laces.

Here is a shoe that will never pinch anybody's foot. It was displayed at a fair conducted by an organization of footwear makers



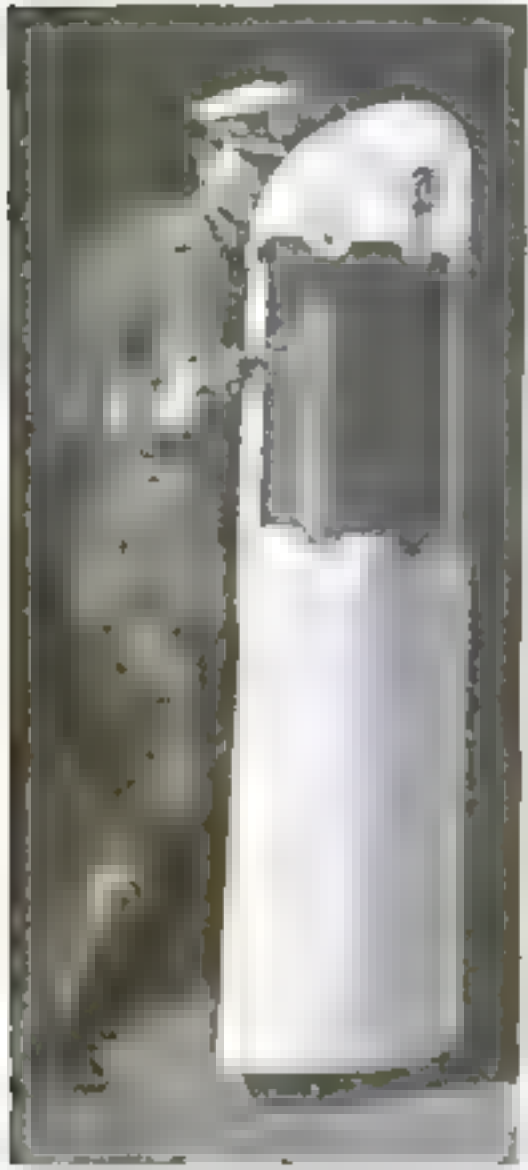
Hydraulic jack and, at right, special vise for removing plane tires

JACK SPEEDS TIRE CHANGE FOR PLANES

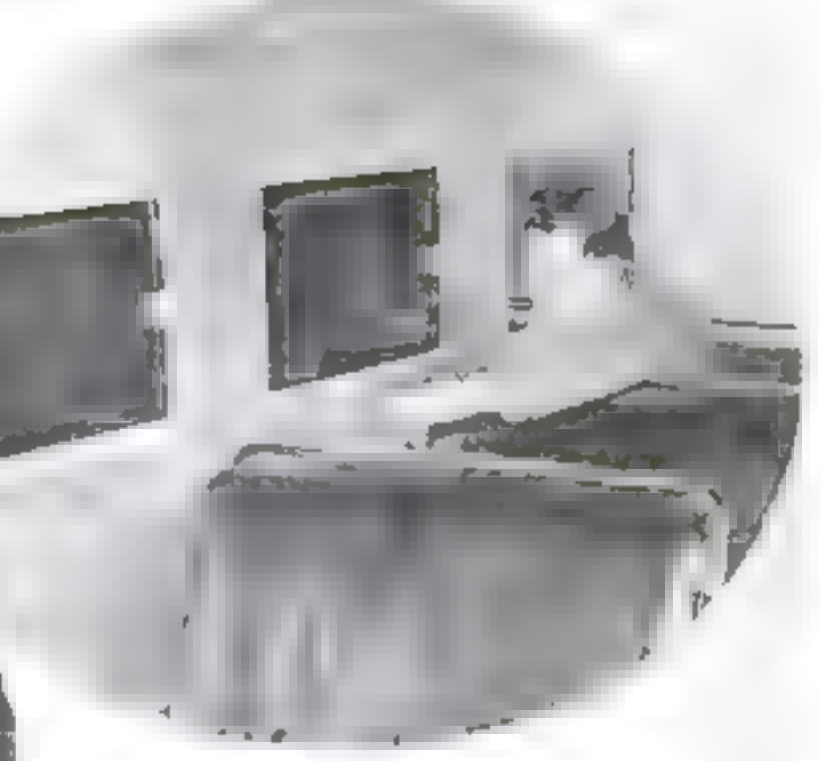
AIRPLANE tires are quickly changed with a new apparatus just introduced. When a plane wheel is laid on the hangar floor, steady pressure is applied to the inside rim of the deflated tire by a hand-operated hydraulic jack mounted as shown at the left. Thus loosened, the tire is easily removed when the wheel is clamped in a vise specially made for the purpose.

BULLETPROOF POLICE PATROL BUS IS ROLLING FORTRESS

The bulletproof shield shown below is a part of the equipment carried in the patrol bus



From this fort on wheels Milwaukee, Wis., police can battle with rioters



Guns are fired through slots which close automatically when weapons are withdrawn

AN ARMORED, streamline patrol bus provides Milwaukee, Wis., police with a mobile fort for emergency use. Capable of carrying twenty-five men at speeds

up to sixty miles an hour, the vehicle is completely bulletproof. The armored body is constructed of layers of steel, hardwood, felt, and a special type of bullet-

resisting aluminum, while the windows are bulletproof glass. Steel-mesh shields which protect the tires can be lowered flush with the ground, if desired, and the motor is so installed that it can be repaired from inside the car. Slots and gun holes close automatically when-

ever rifles or revolvers are withdrawn. Its makers claim that the mobile fort is completely "immune" to bullets from most small arms and machine guns.

JETS OF WATER CLEAN WINDSHIELD



The touch of a button starts these fountains playing on the windshield

At the touch of a button on the instrument panel, a new automobile accessory cleans the windshield by spraying it with jets of water. Vacuum-operated, the device draws water from a tank under the hood and ejects it through small nozzles at the base of the windshield, washing dirt, dust, and grime from the glass.

OIL FLAMES DRY MUDDY RACE TRACK

Muddy race tracks may be dried out to a firm running surface with the aid of a heating apparatus recently tested at Santa Anita, Calif. Resembling a road machine for applying asphalt, the device generates a heat of about 3,000 degrees F. at about three feet from the ground. Kerosene-fueled torches play upon steel plates that line the bottom of the machine.



Pulled along a race track, the machine throws heat down onto the ground

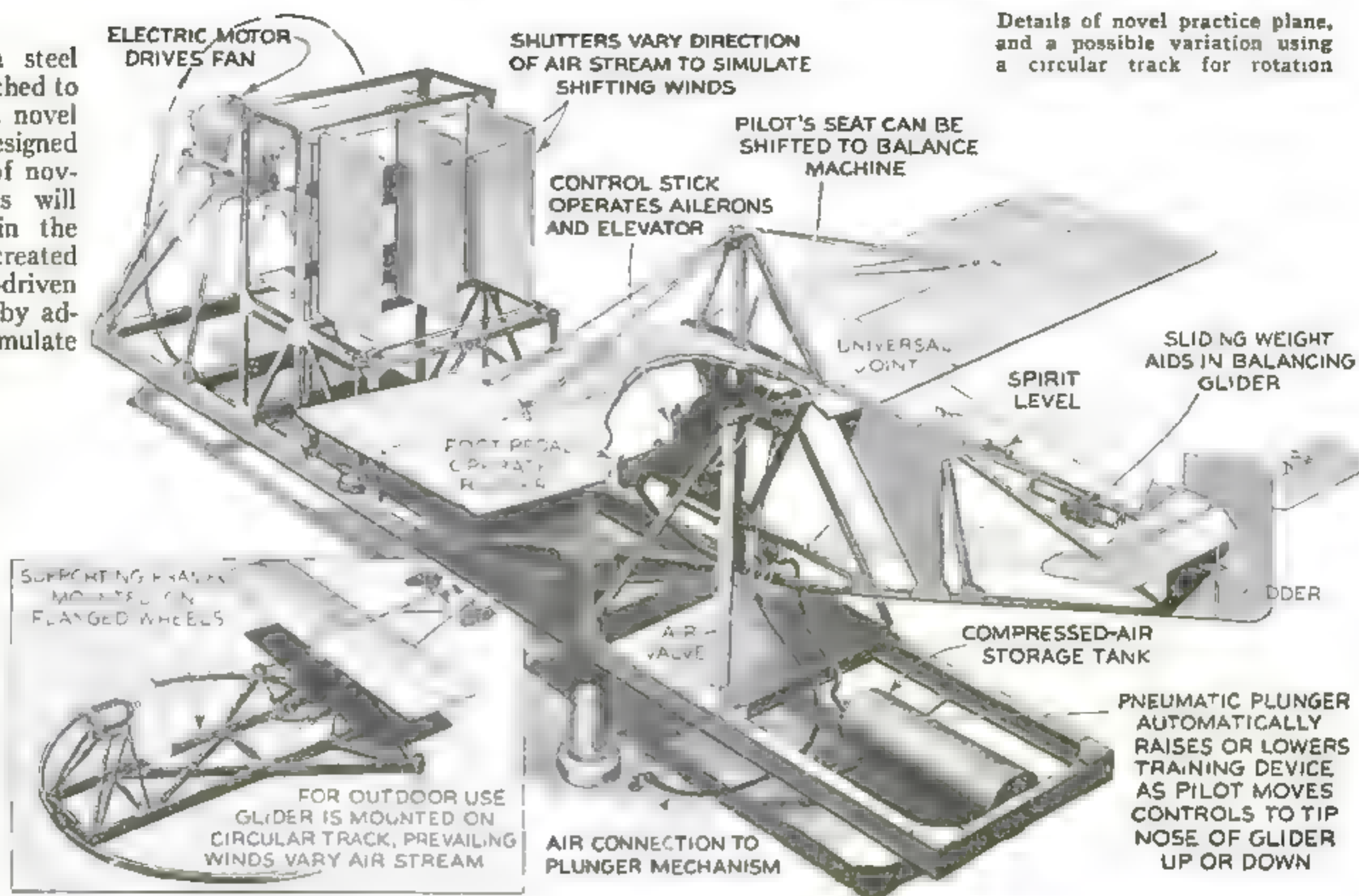


BONE BRACE HELPS SET FRACTURED HIPS

SCIENTIFICALLY designed by Dr. Roger Anderson, of Seattle, Wash., a new bone brace is hailed as a major improvement in the treatment of fractures of the hip. Shown at a recent convention of orthopedic surgeons, the apparatus consists of a complicated arrangement of adjustable steel supporting strips which are fitted around the thigh bones of the patient. Properly applied, the device is said to enable the victim of a broken hip to sit up immediately after a fracture has been set, thus eliminating the necessity for long, tedious periods of idleness. In the photograph above, it is being demonstrated on the lower part of a human skeleton.

TRAINING GLIDER BANKS AND DIVES LIKE A REAL PLANE

MOUNTED on a steel framework attached to a pneumatic hoist, a novel training glider is designed for safe instruction of novice pilots. Students will "fly" the machine in the face of an air stream created by an electrically-driven propeller and varied by adjustable shutters to stimulate changing wind conditions. Suspended on a universal joint, the glider is designed to bank and tilt in response to airplane-type controls. The "stick" is connected to a compressed-air tank by a control valve so that forward and backward motions of the stick will operate the pneumatic plunger to raise or lower the apparatus. Another system has the unit mounted to rotate on a circular track.



Paper record and, below, "electric-eye" pick-up unit



SOUND IS REPRODUCED FROM PAPER RECORDS

SOUND is reproduced from paper records by a novel photo-electric apparatus just invented. Sound vibrations are recorded as a series of fluctuating lines on a strip of paper which is wound around a revolving cylinder. As it slides along a bar in front of the cylinder, a pick-up device casts a beam of light on the sound sheet. Reflected into a photo-electric cell, the fluctuating light beam is transformed into electric current to operate a loudspeaker unit for reproducing the original sound. Duplicates of the paper record are made by photographing the reflected light beam and etching its track pattern on a metal plate used to print paper copies.

MODEL CITY HAS 380,000 BUILDINGS

MORE than 380,000 miniature buildings carved out of balsa wood will be incorporated in a model of the city of Chicago, Ill., now being constructed. measuring thirty-eight by twenty-two feet, the three-dimensional map will provide a view of the city comparable to that obtained from an airplane at an altitude of 10,000 feet. Twenty workers have been modeling on the project for over a year. When completed, the model city is expected to be of special value in solving traffic problems.



Part of a thirty-eight-foot, three-dimensional map of Chicago, Ill.



A chemical in this device renews typewriter ribbons

ATTACHMENT RESTORES TYPEWRITER RIBBONS

TYPEWRITER ribbons are rejuvenated by a new appliance that restores the ribbon fabric to its original condition. Wound all on one reel, the ribbon is threaded into the device and then passed slowly through it, while a chemical solution renovates the fabric. Since it is claimed that eighty-five percent of the ink is still retained in frayed ribbons, the manufacturers state that the device makes worn ribbons almost as good as new.

Census Records Preserved on Film

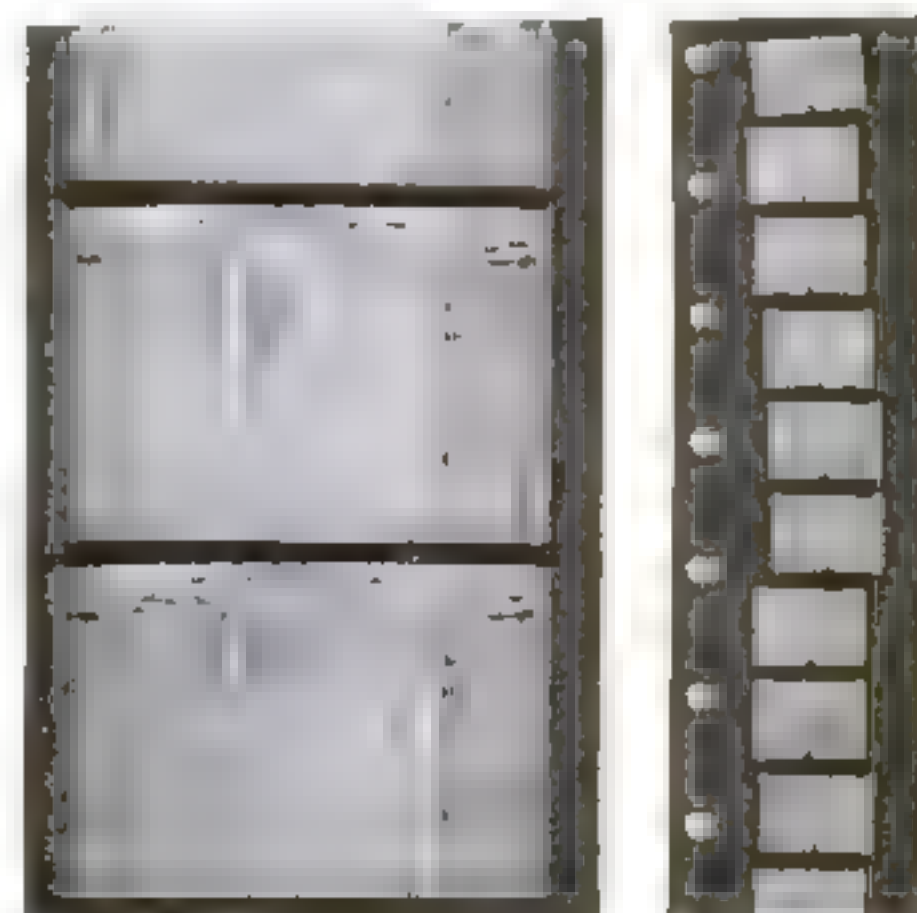
Specially designed camera being used to photograph pages of census records

USING ingenious new photographic equipment, the U. S. Bureau of the Census is copying its voluminous records in microscopic size to safeguard them and to save wear and tear on the original documents. Open volumes are placed on a sliding carriage beneath a special camera which moves up or down on a graduated supporting column. Correct focusing is automatic, being ac-

complished simply by adjusting the camera so that a rectangle of light projected from within the camera just covers the page to be copied. Flood lamps are then switched on, the focusing light turned off, and the camera shutter is snapped by pressing a foot treadle. The carriage then automatically slides the volume over so that the opposite page can be photographed. On a single 100-foot roll of the thirty-five-millimeter film, from 825 to 850 newspaper-size pages can be copied. Smaller cameras using sixteen-millimeter film will copy census records now entered on cards. For reference, film will be put into a projector that throws a magnified image of the desired page on a screen.



This projector throws a magnified image of a page on a screen. Right, two sizes of film with census data



LUMINOUS PAPER LIGHTS DARKROOM

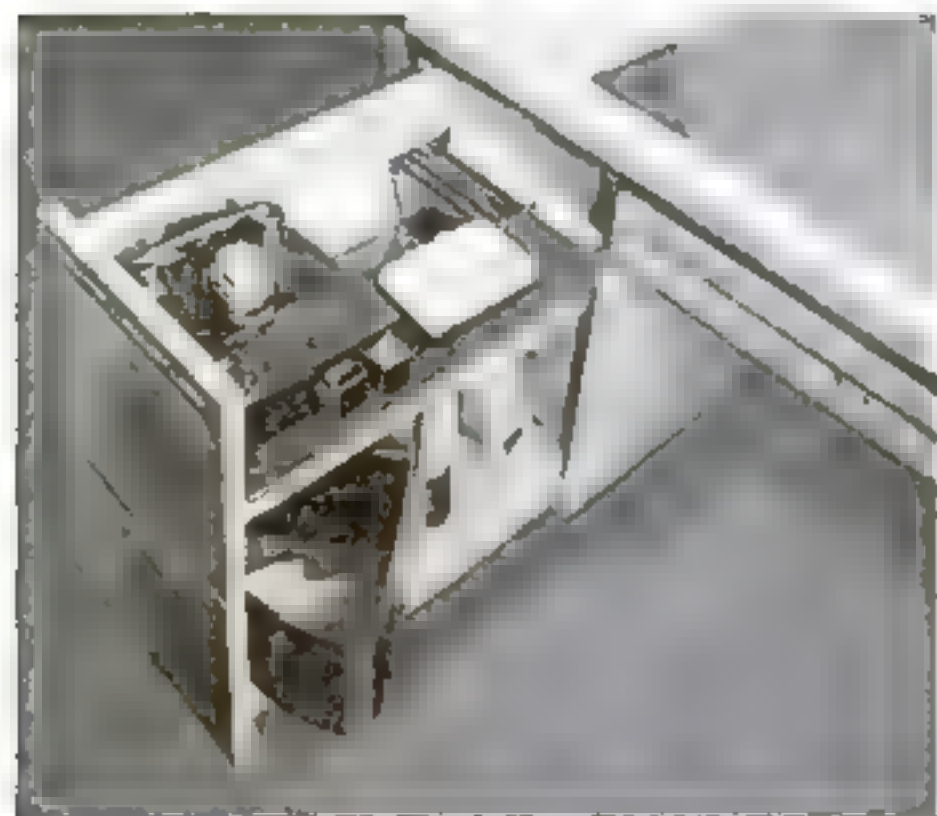
MOUNTED on a dark-room wall, a new luminous paper is said to provide an inexpensive and efficient safe light for use in developing any type of photographic film. Gummed on one side for easy mounting, the paper is coated with a special phosphorescent salt that gives a soft, greenish glow after a short exposure to white light. When the glow fades, it can be restored easily.



Exposure to white light makes the paper luminous



DESK DRAWER HOLDS WASTEBASKET



A handy compartment houses many conveniences

TELEPHONE, wastebasket, bookshelf, and other conveniences are compactly housed in the left-hand side of an all-metal desk just placed on the market. Taking the place of three conventional drawers, the compartment slides out from the desk as one unit. The top of the new desk is coated with a chemical solution that makes it immune to ink spots or other stains, and preserves the original top finish for an indefinite period.

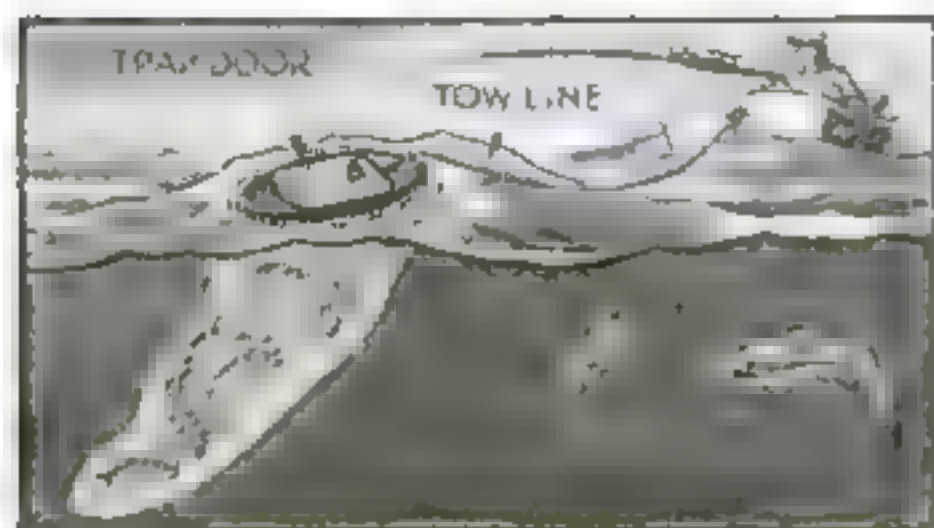
LIQUIDS PACKED IN PAPER BAGS

Nicknamed "paper tin cans," novel containers made of specially treated paper are said to hold liquids indefinitely without danger of leaking. Resembling transparent paper bags, the new containers are designed for use with foods, paints, or drugs instead of cans or bottles. In the top photo, wine is being poured from one of the paper packages, while the lower illustration shows containers of various sizes and shapes holding such liquids as orange juice, motor oil, coffee, and wine, and even carbon dioxide gas.

DARE ARCTIC IN KAYAKS WITH OUTBOARD MOTORS

Using frail kayaks equipped with light-weight outboard motors, a party of three German adventurers recently completed a dangerous exploring trip along the coast of Spitsbergen, far north in the Arctic Ocean. With their tiny craft, lighter than conventional canoes, the explorers were able to penetrate through floating ice into the shallow waters of bays and inlets that would have been virtually impossible to approach in boats that were heavier and more solidly constructed.

TRAP-DOOR NET HOLDS ANGLER'S CATCH



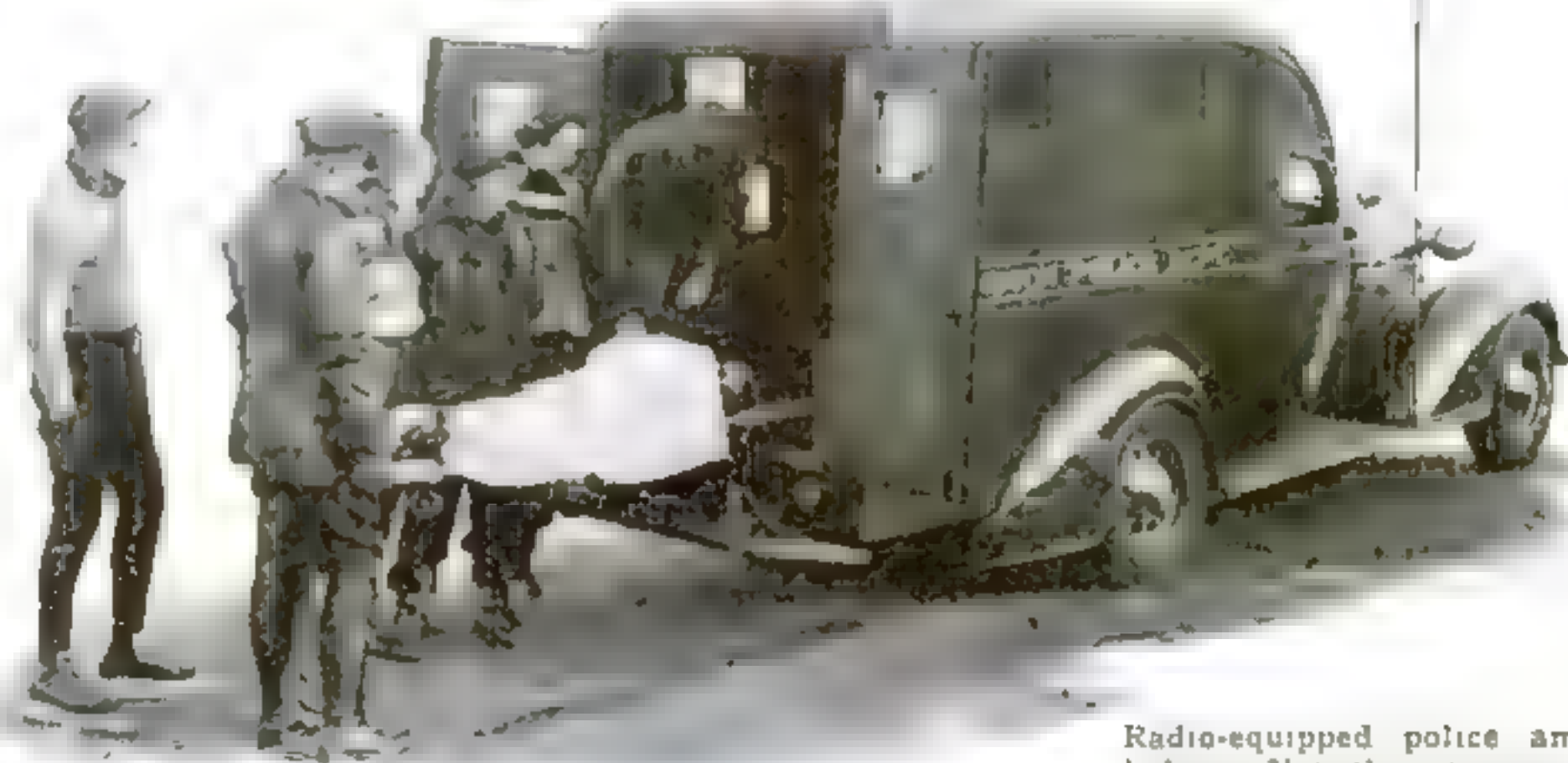
The door of the net is kept closed by the pull of the tow line

ANGLERS can bring their day's catch back alive with the aid of a novel trap-door net just introduced. When caught, fish are put into the net through a hinged door which is then held shut by the pull of a tow line connecting the net to the fishing boat, as indicated in the sketch above. The net folds up flat when not in use.



German explorers with frail craft in which they cruised along the icebound coast of Spitsbergen

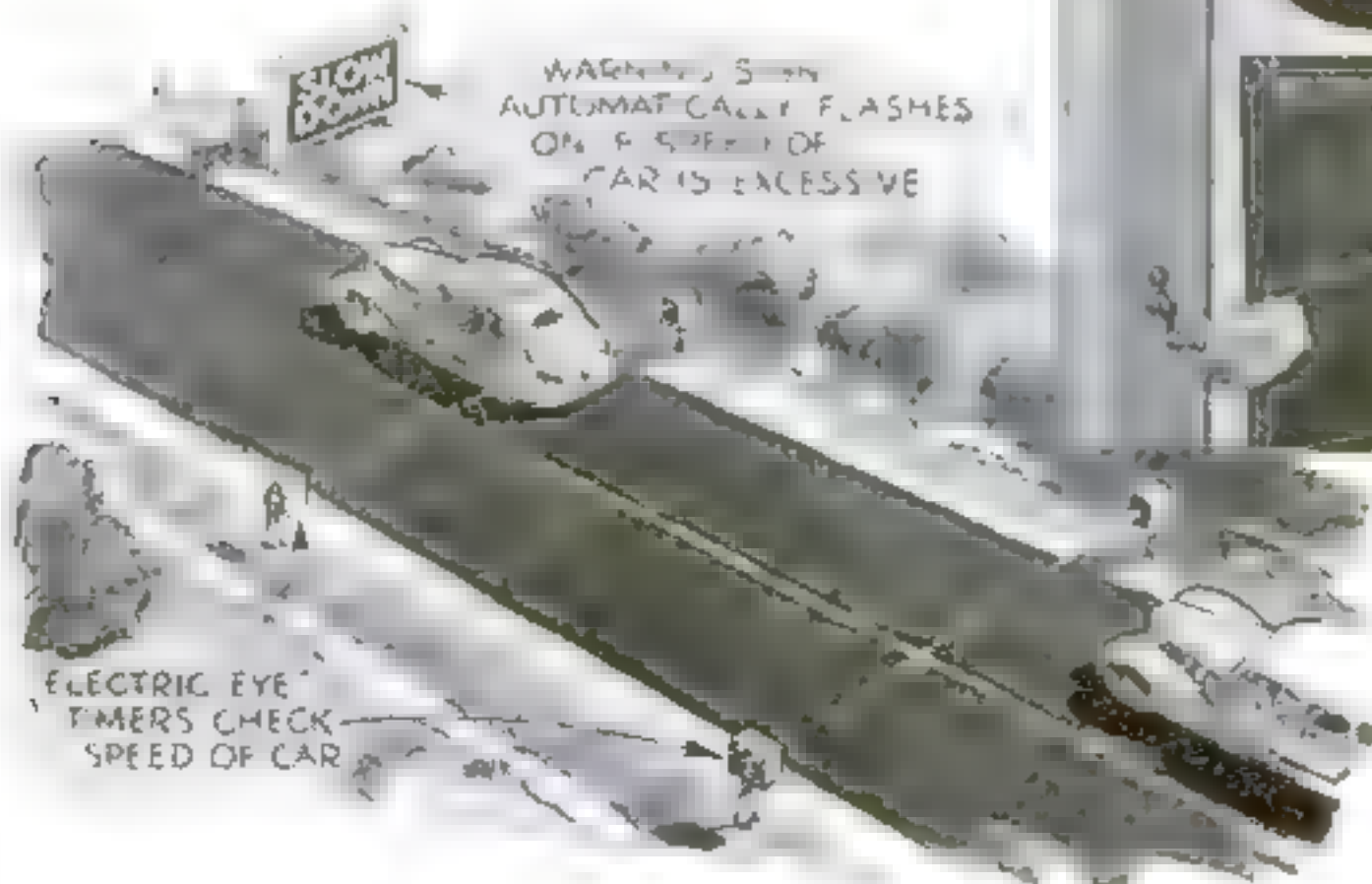
AMBULANCE HAS TWO-WAY RADIO



Radio-equipped police ambulance. Note the antenna rod

"ELECTRIC EYES" WARN SPEEDING CARS

INSTALLED on a highway, a new photo-electric device flashes on an electric sign that warns motorists who are exceeding the speed limit. Cars racing down a road interrupt the beams of two "electric eyes," as shown in the sketch below. Automatic timers check car speed between the two beams; if it exceeds the limit, the electric warning sign flashes on. The apparatus is expected to prove especially valuable near dangerous curves and intersections.



The inventor demonstrating his photo-electric speed indicator with a working model

How "electric eyes" light a warning sign when a car speeds by

EQUIPPED with two-way, short-wave radio apparatus, an ambulance operated by Evanston, Ill., police speeds an accident victim to the hospital while attendants advise medical authorities of the immediate needs of the injured person. In this way, doctors are forewarned, and the hospital operating room can be made ready while the ambulance is on the way. Intercommunication between the ambulance and cruising police cars is also made possible by the radio installation.

VACUUM CLEANER AIDS LUNG-DISEASE VICTIMS

BLOWING UP a patient's lungs with a reversed vacuum cleaner is the odd method devised by a physician in London, England, as an emergency treatment for certain pulmonary and heart diseases. The dust bag of the cleaner is taken off and replaced by a small spring valve that regulates the pressure of the air blown out by the machine. This air is blown into the patient's mouth or nose by means of any convenient tube or mask. The automatic muscular action of breathing permits the air to pass on to the lungs, where its pressure forces a complete expansion of parts of the lung that tend to collapse.

Latest Conveniences



SERVING CART

Built like a pushcart, this novel serving wagon has a sliding tray that covers a compartment for accessories



FIRE SCREEN IS MADE OF GLASS

Shown above with a mantel and hearth also of glass, it does not obstruct the firelight



SPLASHPROOF EGG BEATER

Replacing the usual wings in the beater at the left is a wheel that lies low in the mixing bowl and therefore will not spatter



VANITY MIRROR HAS CABINET DOORS. When the doors of a new vanity cabinet are closed, they conceal the full-length mirror. Opened, they present shelf space for cosmetics and toilet articles



LIGHTED BATHROOM SCALE

A novel feature of this streamline bathroom scale is an electric dial light, operated by a battery, which comes on whenever the scale is used



FOR SPRING CLEANING

Fitted with a mop of lamb's wool that absorbs dust, the handy little brush shown at the left gets into bed-spring coils and many odd corners

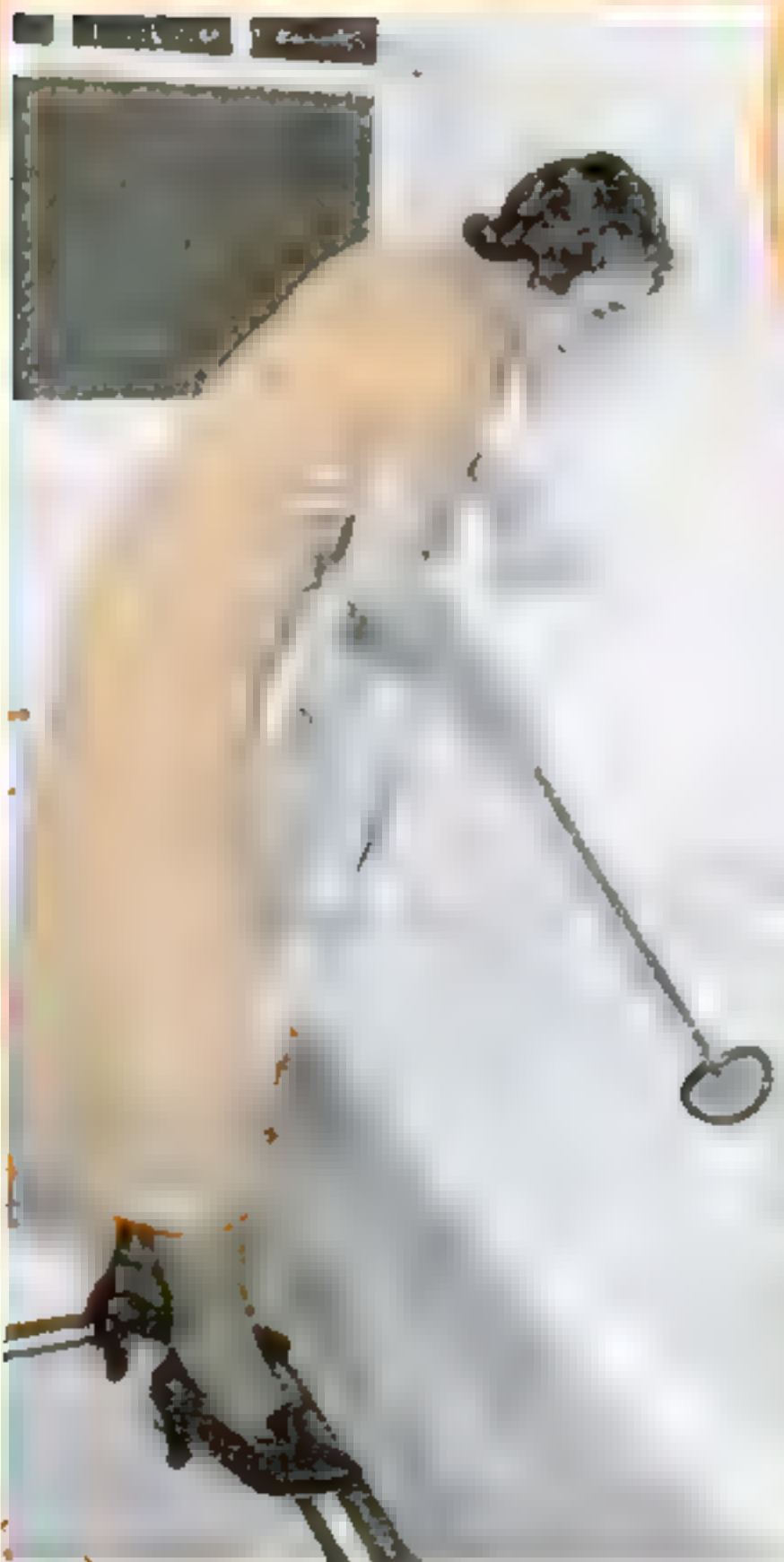
for the HOUSEHOLD



NEW FLOOR LAMP HAS SWIVEL ARM

With the novel floor lamp at the right, it is possible to have light wherever it is needed. The bulb and shade can be swung out over a bridge table on a double-jointed arm.

INSULATED MILK BOX. The photograph at the left shows a new all-metal, heat-insulated holder for milk bottles. In summer, it keeps the milk cool. In winter, an electric bulb can be lighted to give heat when milk is delivered.



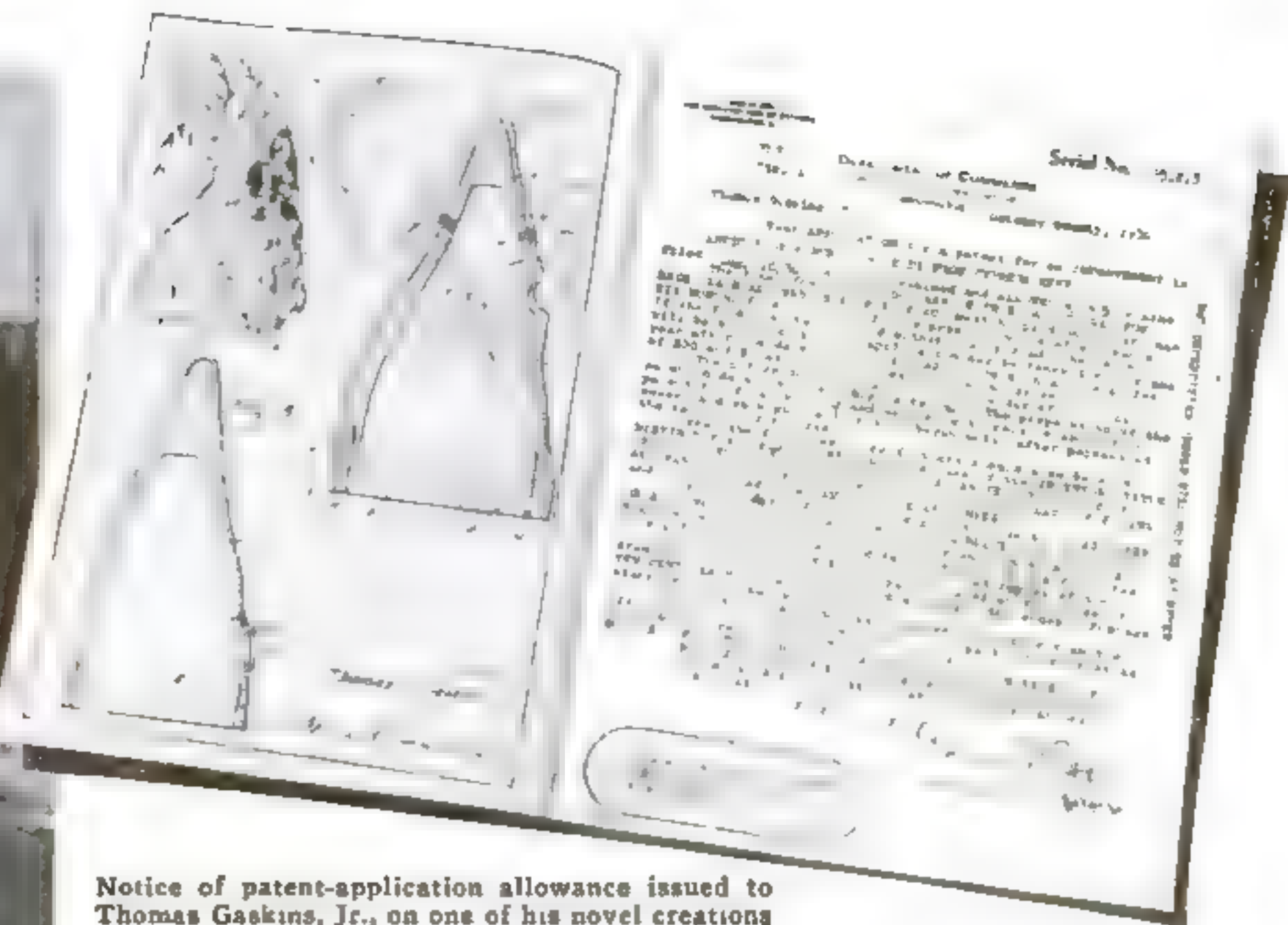
BATHTUB RING REMOVER. The task of cleaning the bathtub is made easy by a brush that has a sponge-rubber shoe mounted by a spring joint on a long-handle that eliminates back-breaking stooping.

FOLDING IRON

Because it folds compactly, the electric iron seen at the right makes a handy spare unit for the home. Intended primarily for traveling, it is fitted with a six-foot extension cord and a neat suede felt bag.



LINE ON SHEET SIMPLIFIES BED MAKING To take the guesswork out of bed making, sheets now have a color-fast line stitched into them. By placing the line flush with the edge of the mattress, as shown at the right, the right amount of tuck-in is provided.



Notice of patent-application allowance issued to Thomas Gaskins, Jr., on one of his novel creations

Tree-Root Craftwork Forms Unique Business

MERELY an interesting freak of nature to most observers, the "knees," or strange conical growths that form on the roots of cypress trees, have proved a profitable source of income to Thomas Gaskins Jr. of Arcadia, Fla. By fashioning them into rustic flower vases, bird houses, candle holders, and ash trays, he has made himself proprietor of what is probably the only business of its kind in the country, with customers in thirty states and Canada.

Rising above the high-water level of swamps, the porous "knees" supply air to cypress roots when the ground is flooded. Gaskins harvests them with an ax, on trips that take him as far as thirty miles from home. In his back-yard factory, he shapes his raw material into decorative household articles with long-handled gouges and other special tools of his own manufacture. Since no one, apparently, had thought of putting cypress knees to use before, his application for a patent on one of his products was readily granted.



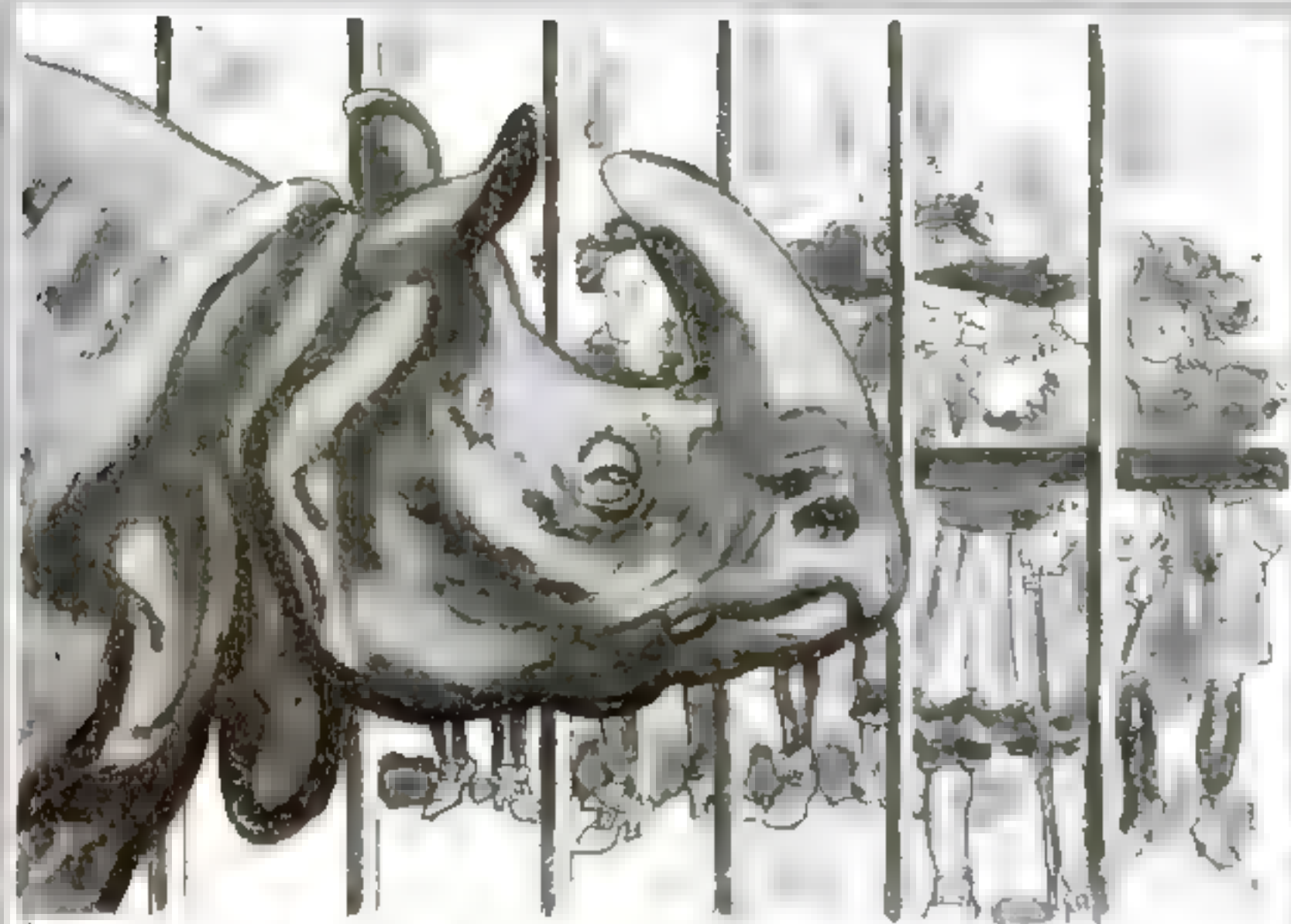
Gaskins at work in his back-yard factory, using tools of his own invention. At left is an ornamental bird house made from a cypress "knee"



Some of the unusual flower holders made from this odd material. In one type, vines are planted in the hollowed-out interior and allowed to grow out through holes cut in the sides as shown in the patent document reproduced above. Right, a storage shed in which prepared "knees" are kept



Un-Natural History By GUS MAGER



IN 1513, WHEN A LIVE RHINOCEROS WAS SENT FROM INDIA TO THE KING OF PORTUGAL, IT CAUSED A GREAT STIR IN EUROPE! THE CRITTER GETS ITS NAME, MEANING "NOSE-HORN," FROM THE FACT THAT THE HORN GROWS FROM THE NOSE RATHER THAN FROM THE FOREHEAD, AS WITH OTHER HORNED ANIMALS



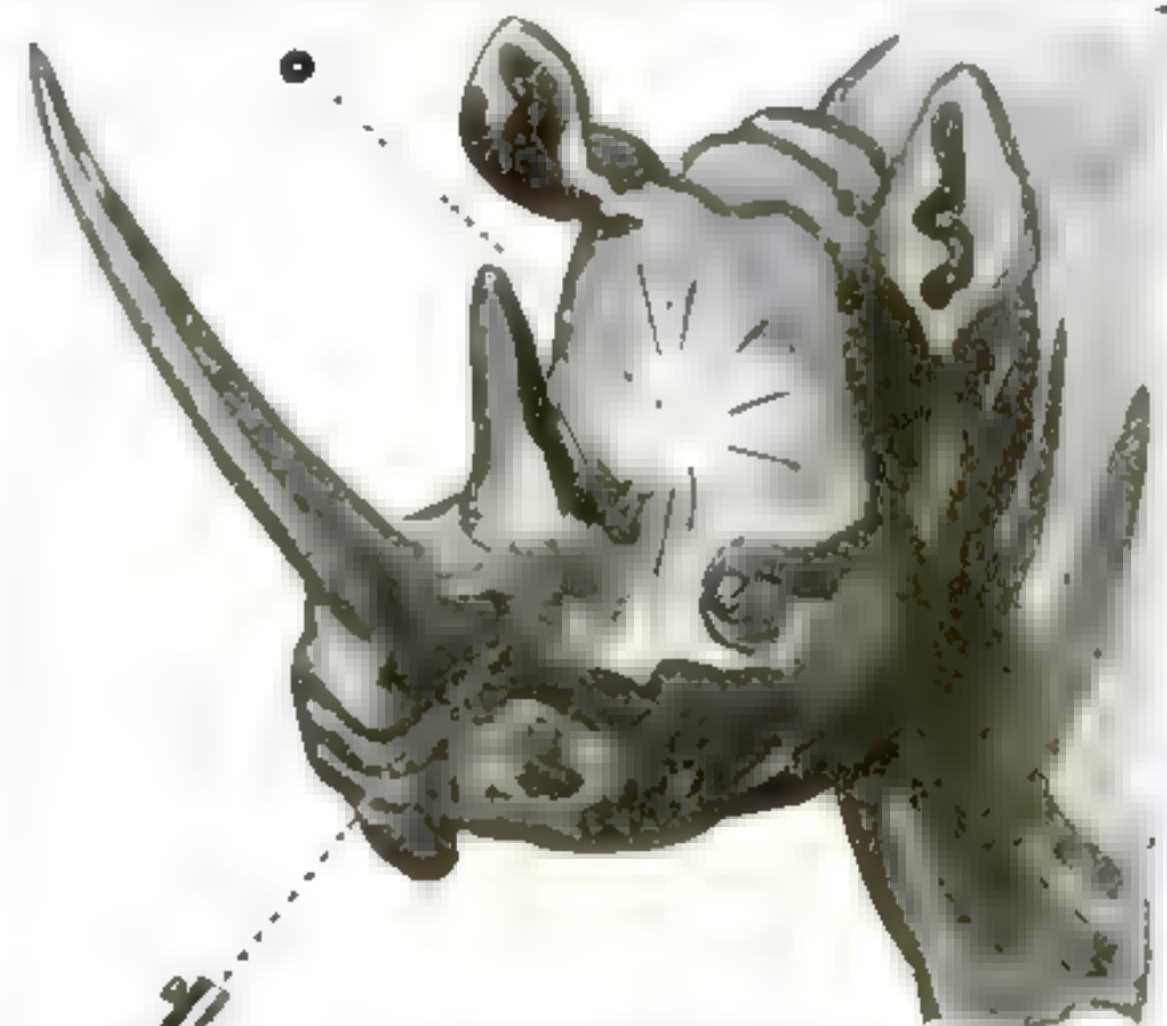
IN PARTS OF CHINA AND ELSEWHERE IN THE ORIENT, POWDERED RHINOCEROS HORN IS CONSIDERED AN INFALLIBLE CURE FOR FEVERS — SO MUCH SO THAT AN INCH OF HORN HAS A COMMERCIAL VALUE OF \$100.



THE RHINO'S THICK HIDE IS NOT NEARLY AS TOUGH AS IT LOOKS! WHEN FRESHLY SKINNED, IT CAN BE CARVED ALMOST AS EASILY AS CHEESE!



HE CAN SLEEP IN COMPARATIVE SAFETY, THANKS TO HIS BODY-GUARD OF RHINOCEROS BIRDS, WHICH WARN HIM OF DANGER BY SCREECHING AND FLAPPING THEIR WINGS!



THE RHINOCEROS IS THE ORIGINAL BONEHEAD! HIS THICK SKULL WILL EVEN TURN A BULLET!



IN MEDIEVAL TIMES, WHEN POISONING WAS A FAVORITE INDOOR SPORT, IT WAS BELIEVED THAT A CUP MADE OF RHINOCEROS HORN WOULD INSTANTLY BETRAY THE PRESENCE OF KNOCK-OUT DROPS BY SHOWING FINE BEADS OF SWEAT ON THE OUTSIDE. CHEMISTS HAVE DEBUNKED THIS IDEA!



OF THE FIVE DISTINCT KINDS OF RHINOS, THE INDIAN AND THE JAVAN VARIETIES HAVE ONLY ONE HORN, WHILE THE AFRICAN TYPES HAVE TWO, THREE, OR EVEN FOUR HORNS. ONE FREAK SPECIMEN HAS BEEN REPORTED WITH FIVE HORNS!

Homemade Detective

MATCHES BULLETS

By
Gaylord Johnson



Comparing a "fatal bullet" with one from a suspected weapon. Images are joined, as in inset, to match grooves

to match up fingerprints, samples of handwriting, and typewriting, and any other objects that require careful side-by-side comparison.

Before we begin the actual construction of our homemade microscope, however, let us go over the general design of the accurate comparison instruments used by full-fledged detectives. The professional comparison microscope, used primarily for matching bullets, is a double-barreled

TRACING a bullet to the rifle or pistol barrel that fired it, and positively identifying a "murder gun," is now a routine procedure in every well-equipped police laboratory in the world. Every reader of detective stories knows that gun identification is accomplished by comparing the grooves on test bullets, fired from suspected firearms, with the grooves on the "fatal bullet." But the apparatus needed for bullet comparison is supposed to be beyond the means of the amateur who would like to try the actual laboratory methods for himself.

High cost is, of course, unavoidable in the highly-finished and absolutely accurate "comparison microscopes" supplied to police laboratories. But the optical principles of the comparison microscope are very simple indeed. With material costing little more than a dollar, you can build an instrument that will give you the thrill of identifying bullets successfully. Also, your homemade apparatus will enable you

instrument, each tube of which carries an "objective" lens at its lower end. Each of these lenses is placed directly above the side of one of the two specimens to be compared. The usual practice in mounting bullets for comparison is to attach them with beeswax or modeling clay to the faces of little disks which can be slowly revolved by the fingers, while the eye watches through the microscope eyepiece for matching grooves.

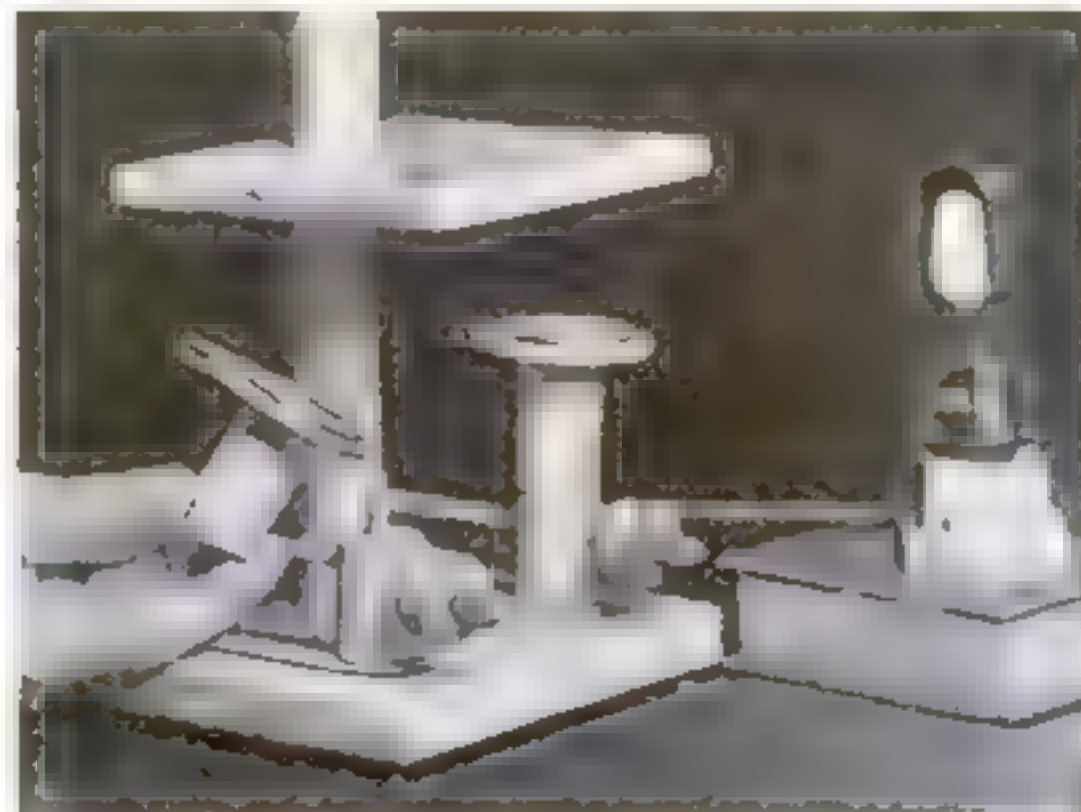
A suitable arrangement of mirrors bends the rays coming from each objective, and combines the two bullet images in such a way that they form a single field, split in two by a narrow line. The grooves on the two bullets are thus made to meet, end to end.

When bullets fired from the same gun are examined, and one is slowly revolved, the grooves on the half fields eventually match and can be traced continuously across the two images. But if the bullets are not from the same weapon, no such matching position can be found for them.

Since the first essentials of any microscope are the lenses, we shall dispose of them first. Nothing more costly is required for the objectives of your double-field instrument than two of the ordinary "linen-counter" folding pocket magnifiers of the type shown in one of the illustrations. They are obtainable from any optical store for about fifty cents each. The single additional lens needed is obtainable from the ten-cent store for a dime. It is a simple hand magnifier about an inch and a half in diameter, and of about four-inch focus.

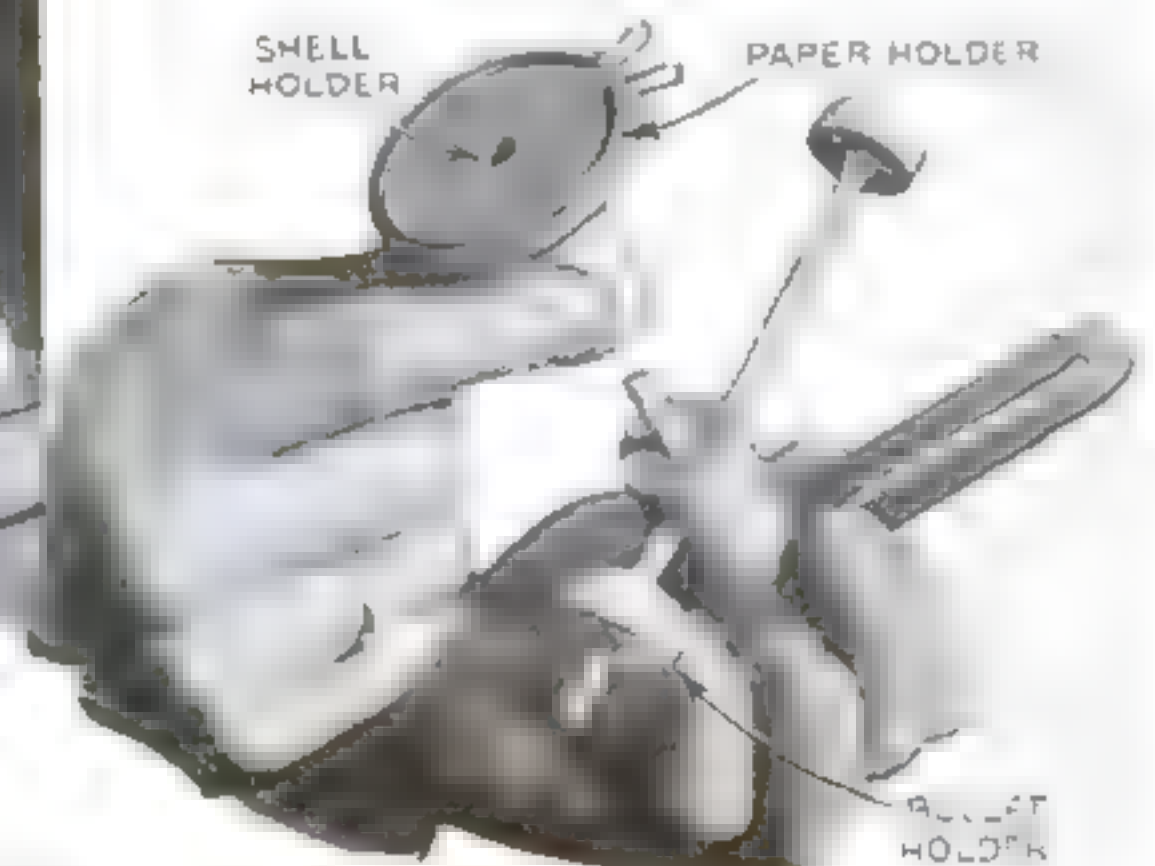
You can determine the focal length by looking through the lens at newsprint and noting the distance from the paper at which it shows the largest clear image.

The construction of your comparison



Auxiliary stages are provided for comparing fingerprints, specimens of handwriting and typewriting, and other objects side by side

The picture at the right shows how the circular stages rest on pivots above the bullet holders



Microscope

AND FINGERPRINTS

microscope is shown clearly by the photographs and working drawings on these pages.

The model shown was constructed of the simplest materials, available anywhere. All that is needed are a few pieces of plywood, some one-inch and quarter-inch dowel rods, several thumb set screws, a couple of one-inch wing-nut bolts, some two-inch package-sealing tape, and a few bits of ordinary mirror glass.

The base and supporting pillar for the apparatus are made from a piece of the plywood with a section of one-inch dowel rod set into a hole and glued in place. Four thumb tacks, forced into the under surface of the base, form the feet of the apparatus.

Along the back of the pillar, a piece of quarter-inch dowel rod should be glued, to

serve as a guide rail to keep the objectives in line with the objects to be examined.

The bullet holders are constructed easily from short pieces of one-inch and quarter-inch dowel rod, and bits of cigar-box wood. The upright cylinder of the bullet holder is fastened to the sliding supports by a flat-head screw so that it will turn with a little friction. The bullet-holder axle is also fitted to turn with a little friction in the hole in its supporting upright cylinder.

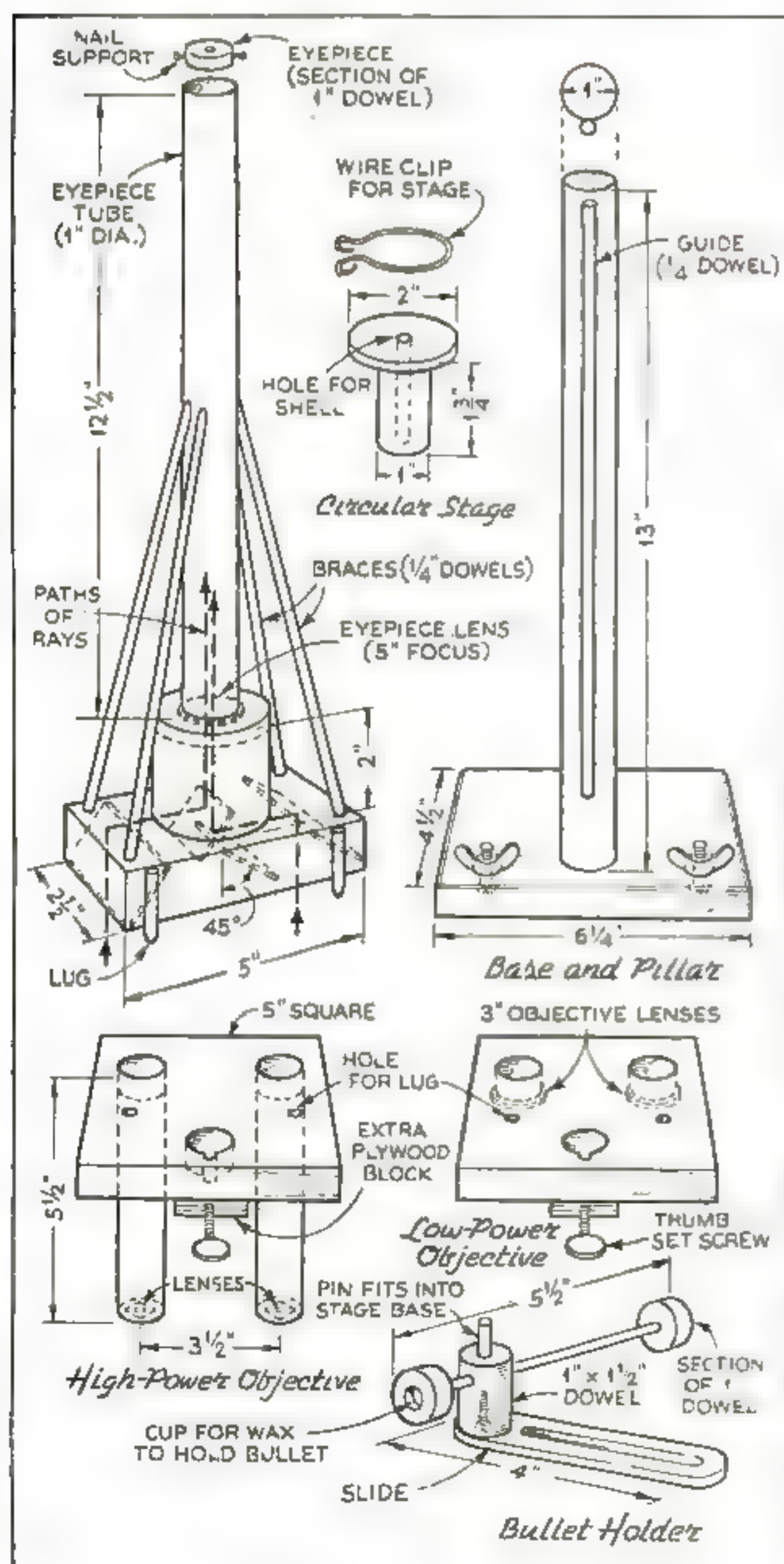
In the tops of these little upright cylinders, short pieces of quarter-inch dowel rod are glued, and these fit into holes in the cylinders of the circular "stages," which rest and turn upon the bullet holders below.

One purpose of these circular stages is to support and rotate discharged cartridge shells for comparison of the firing-pin and breech-block markings impressed on them when they were fired. Holes of suitable size to admit the largest shells to be examined are bored in the centers of the circular stages. Smaller shells are wrapped with paper until they fit the holes.

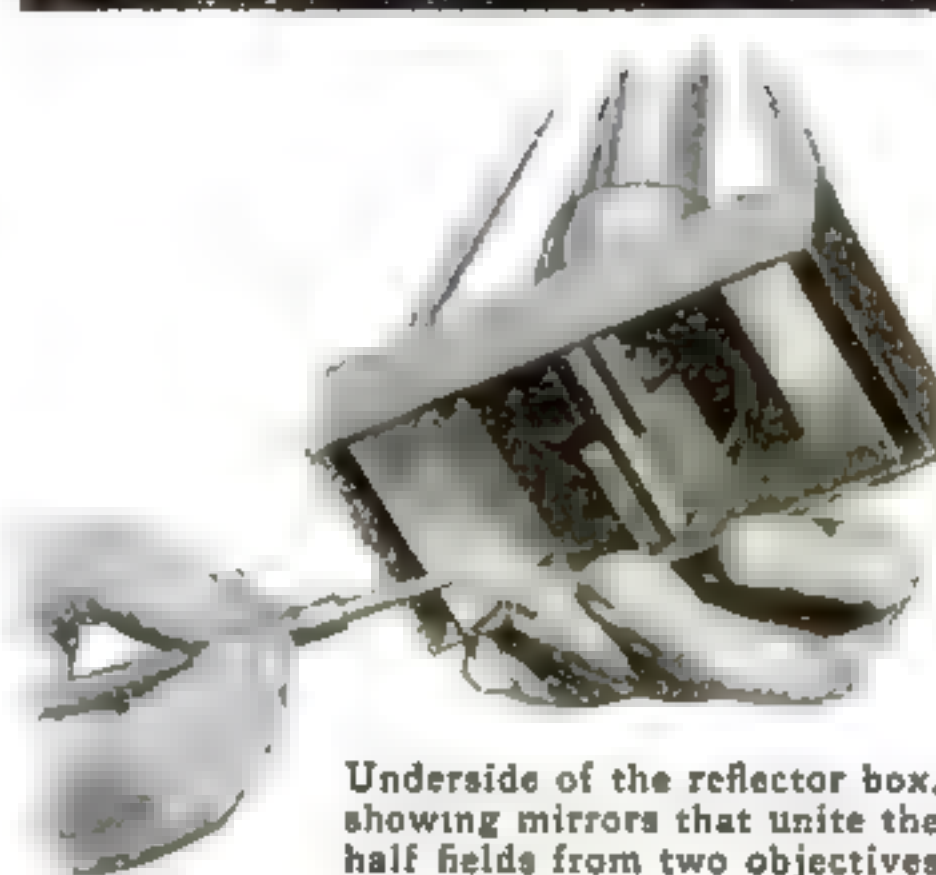
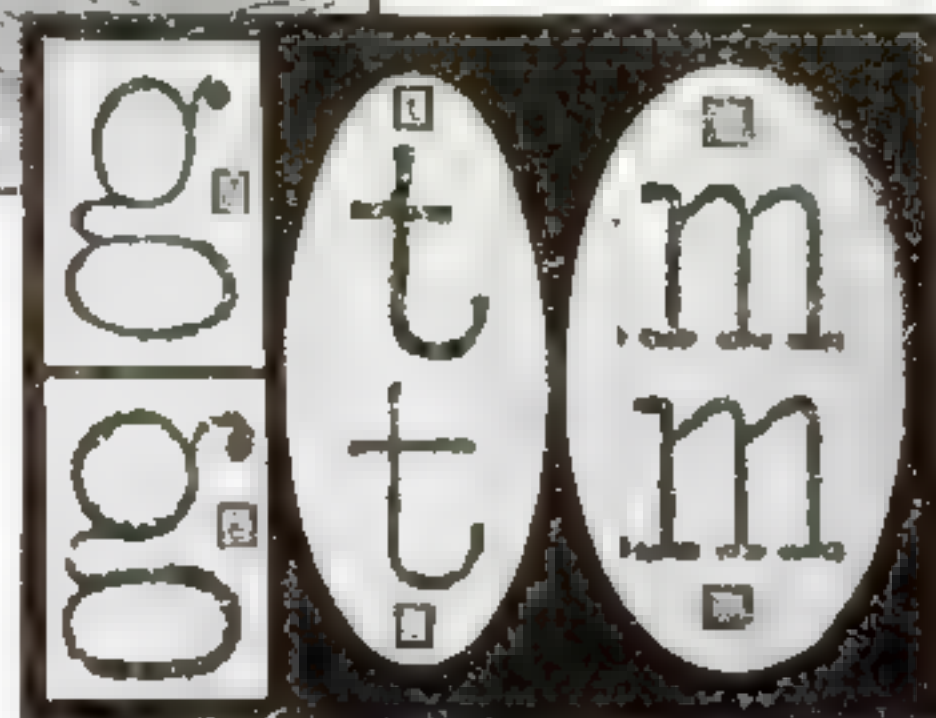
The other purpose of the circular stages is to support pieces of paper, glass, or other material which are being examined for the matching of the fingerprints they carry, or for comparison of samples of typewriting or handwriting.

The sliding members, thumb nuts, and axles of the bullet holders are provided to make it easy to adjust the bullets, finger-

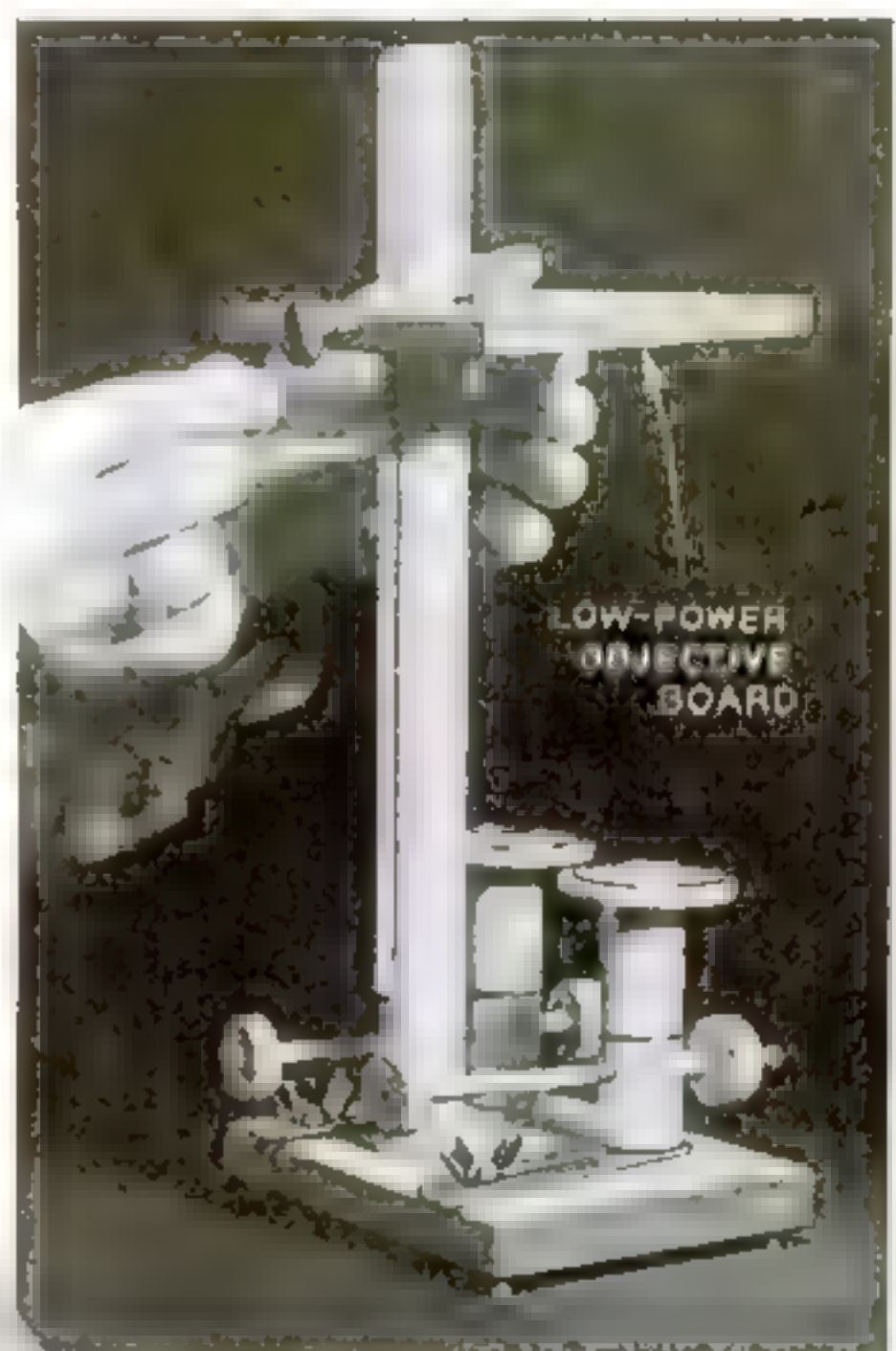
Below are shown the inexpensive lenses used. The "linen counter" costs about fifty cents, the others just a dime apiece



Fingerprints, magnified to look like the one at the left, can be compared side by side. Below, differences in letters typed on different machines, as revealed by the lenses of the microscope



Underside of the reflector box, showing mirrors that unite the half fields from two objectives



For examining fingerprints, typing, and handwriting, a platform carrying three-inch-focus lenses is substituted for the high-power objective board that is used in comparison of bullets



Tin-Can Home Chemistry

REVEALS PROPERTIES OF
A VERSATILE METAL

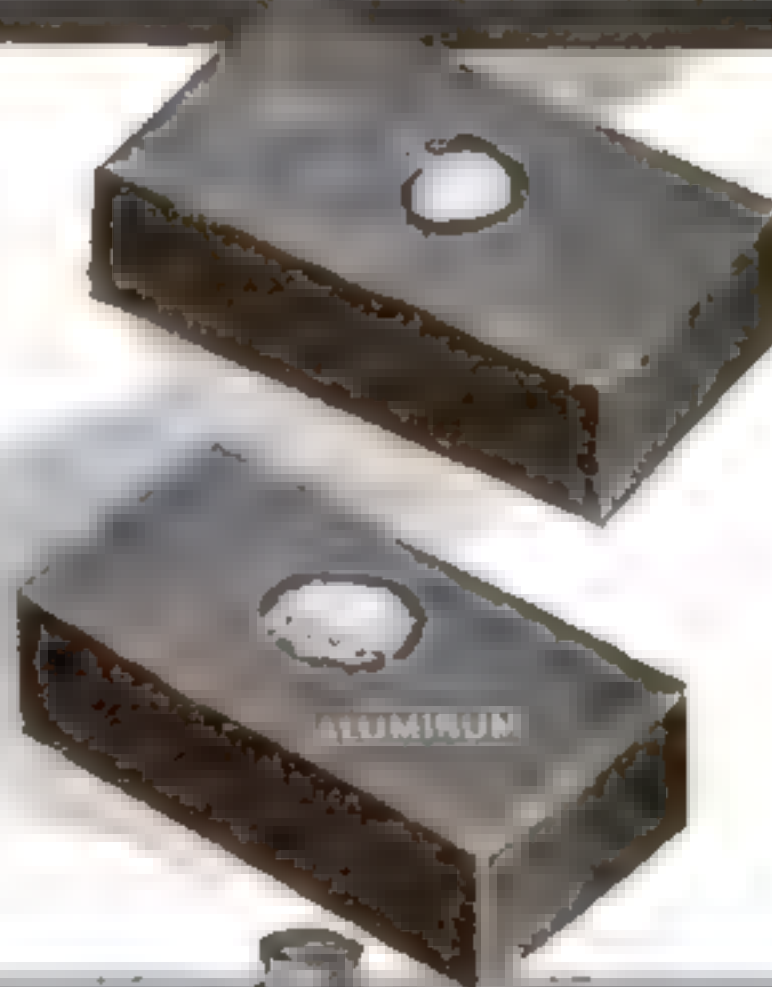


To see whether a piece of foil is of tin or of aluminum, roll small pellets of it and place them on a charcoal block. When heated with the pointed flame of your mouth blowpipe, tin will fuse into a malleable bead, while aluminum will burn to an ash.

WHEN you experiment with tin in your home laboratory, you are making the first-hand acquaintance of one of the most useful and versatile of metals. Long before foods came in cans, and confections in wrappings of glistening metal foil, tin was helping to shape the world's history. The Romans who conquered Britain in ancient times, it has been suggested, may have been impelled at least in part by their need for tin. Alloyed with copper to make bronze, this metal served for tools and weapons long before the secret of hardening iron had been discovered.

As early as 1,000 B.C., men were working the famous tin mines of Cornwall, England, which, even until recent years, produced most of the world's supply. Today, ships bring the bulk of it from the Malay Peninsula, from Bolivia, and from the Dutch East Indies. With no tin mines in the United States or in our possessions, we depend upon imports for the tin that we make into tin cans, collapsible tubes, tin foil, common pins, roofing sheets, and a wide variety of useful alloys including bronze, some types of brass, solder, pewter, type metal for printing, and bearing metal for machinery.

Many of the industrial uses of tin depend upon two outstanding properties—its easy fusibility and its resistance to tarnishing. Its melting point of only 232 degrees centigrade, nearly 100 degrees below that of lead, is the lowest of any of the familiar metals except mercury. As for its corrosion-resisting qualities, sheets of tin have been exposed to moist air for years without harm.



A magnet will stick to a "tin can," proving that there is steel under the coating of tin.

that pure tin replaces the tin-lead mixture, producing the nonpoisonous coating of "tin plate." The wall of a tin can is thus a "sandwich" of steel between layers of tin that guard it against corrosion by food acids and moisture.

You can readily prove that the cans in your kitchen contain steel beneath the tin. Steel is attracted to a magnet, while tin is not, and you will find that a tin can sticks to a magnet held near it. An easy chemical test provides confirmation. Cut a small piece from a can with a pair of tin snips, and dissolve it in nitric acid, diluted with water. Now add a drop of ammonium thiocyanate (sometimes called ammonium sulphocyanide). The solution turns red, because of the formation of iron thiocyanate, showing the presence of iron in the form of the steel in the can.



Crystals of copper nitrate, wrapped in tin foil and moistened with water, form a miniature volcano as tin displaces copper in the salt.

The silvery metallic lining that you have seen inside copper vessels is tin. Applied in the molten state, it provides an armor that prevents the formation of a complex variety of copper carbonate—the same green compound that you have seen on weathered copper roofs, gutters, and drainpipes (P.S.M., Jan. '36, p. 50). Roofing tin, also known as "terneplate," consists of thin sheets of steel that have been passed through a molten mixture of tin and lead to give them a protective coating against the elements. Tin cans are made in exactly the same way, except

With tin currently selling at fifty-one cents a pound, compared with about one cent a pound for steel, you can understand why a tin can is mostly steel, and only the amount of tin necessary for the proper preservation of the contents is used. In fact, many manufacturers now are experimenting with lacquer and aluminum coatings as substitutes for tin.

Tin has a crystalline structure which can be made visible by a simple little experiment. Turn a tin can upside down and place one or two drops of muriatic acid upon it. The etching effect of the acid brings out a curious pattern of leafy tin crystals, resembling the designs produced by frost on a window pane.

Tin foil provides the pure metal in

By
RAYMOND B. WAILES

handy form for a number of home chemical experiments. One caution is in order. Don't be misled into thinking that any metal foil you may come across—on candy, cigarette packages, or elsewhere—is tin foil. Candy bars and most food products are wrapped in aluminum foil. For other purposes, foil made of tin-and-lead alloys is often used. The foil in which cheese is packaged is usually of tin, however, and imported fancy cheeses invariably are wrapped in tin foil. Once you have seen the real article, you will readily recognize it again, for its shiny but gray luster is easy to identify. Any grease or butter that may adhere to the foil may be removed by rinsing it with gasoline or carbon tetrachloride.

If you place small pellets of tin rolled from cheese wrapping upon a charcoal block, and heat them with the pointed flame of your mouth blowpipe, you can easily fuse the metal into malleable beads. When you try the same experiment with aluminum foil, you get a white, fluffy ash instead. The aluminum burns to white aluminum oxide, while the tin is merely melted and is kept from oxidizing, to a large extent, by the hot charcoal. This affords a convenient way of distinguishing between the two kinds of metal foil that are commonly used on foodstuffs.

Try wrapping some crystals of copper nitrate in a wad of tin foil, adding two or three drops of hot water to the crystals from a



TIN DISPLACES SILVER

A piece of tin foil, rolled into a stick and suspended in a solution of silver nitrate, precipitates silver in pretty crystals

pipette or a medicine dropper. In several seconds, as the crystals dissolve, the foil begins to emit crackling noises and starts to quiver. Soon, steam arises. If conditions are right, the experiment usually ends in a miniature volcanic eruption, and the tin disappears. This stunt, for best results, should be performed on a wooden board, rather than on a concrete floor or some other place where the conduction of heat away from the mixture will delay the chemical reaction.

The explanation of the eruption lies in the heat generated by a reaction between the tin and the copper nitrate. When you added water, a solution of the copper salt was formed. Tin displaces copper from solutions of its salts, so in this experiment the tin interacted with the copper nitrate, and metallic copper was precipitated.

Now you know why a Montana villager who threw some old tin cans into a gully carrying waste water from a copper mine was surprised next day to find that they had turned to copper. The tin dissolved in the water, which contained copper sulphate, and metallic copper precipitated in its place. The accidental discovery made the man rich and led to one of the most curious methods of producing copper used today. Discarded tin cans by the thousands are placed in long troughs, and mine water, bearing dissolved copper salts, is allowed to flow over (*Continued on page 128*)

Some Useful Hints on Mixing Chemicals

"SHAKE well before using"—why does one druggist attach this little label to your bottle of medicine, while another, filling the same prescription, does not? Medicines can't always be as clear and sparkling as your favorite drink or gasoline or shaving lotion. But when the ingredients are identical, as in this case, one pharmacist may have been more skillful at compounding them than the other was. The first might stir a liquid into a grease base for days without making them unite; the second can blend them into a smooth, pearly cream within a few minutes.

Tricks in mixing chemicals are useful in the home laboratory, too. One simple aid, for crushing and grinding chemical mixtures, is a rubber grip for the end of the pestle that you use with your mortar. The semi-soft rubber caps sold for use on automobile gear-shift levers are ideal for the purpose. To clean a soiled mortar and pestle in a jiffy, after use, put in several pinches of ordinary kitchen scouring

powder, moisten it, and grind it about. Scouring powder also is useful in cleaning chemical glassware.

Make sure that the chemicals you choose to mix will behave according to your intentions, instead of doing something unexpected. Some compounds react with each other and change their character, even in the dry state, when ground together. A white mixture of potassium iodide and mercuric chloride turns to yellow mercuric oxide under the pestle, as you can readily verify. Rub together ammonium chloride (sal ammoniac) and sodium thiosulphate (photographer's hypo) and you will see the mixture become a wet, pasty mass within a minute. A mixture of potassium chlorate and sulphur explodes when it is ground in a mortar or struck with a hammer; you can safely demonstrate the fact with quantities the size of pinheads.

Deciding what containers to use for mixtures that you prepare also requires some knowledge of their properties. Some dry chemicals can be stored in cardboard boxes.

Others, including ammonium carbonate, quicklime, and iodine crystals, should be kept in glass.

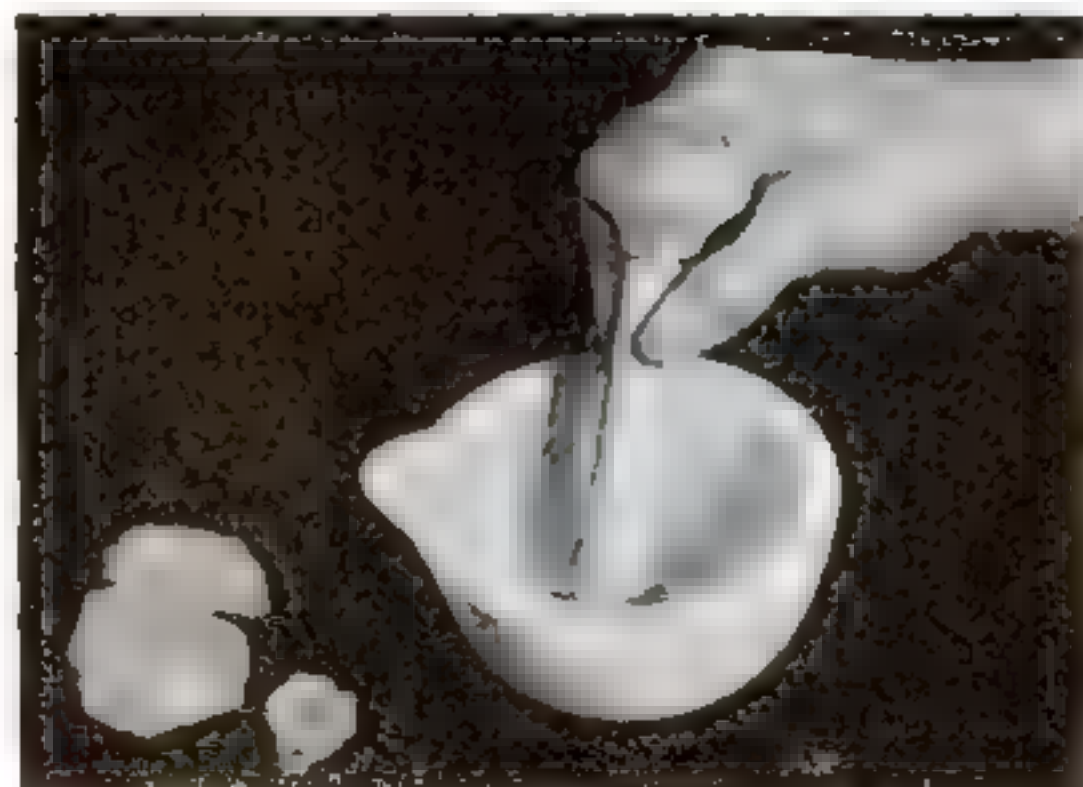
Amber and blue bottles are used for storing compounds that are affected by light, including silver nitrate and many organic chemicals. The tinted glass keeps out light rays that would decompose the substances. Sometimes it is turn about, and the chemical affects the glass container. Alkaline substances attack glass, and glass stoppers should not be used in storing them. The stopper will invariably stick. A rubber one is more satisfactory.

To see how an alkali attacks glass, half-fill a bottle with a solution of lye, or sodium hydroxide,



This experiment shows how an alkaline mixture will attack glass in which it is kept

and keep it at or above the temperature of boiling water for several hours. You can do this by immersing it in a canful of strong salt solution, which can be kept at a higher temperature than 100 degrees centigrade, taking care to clamp the can securely so that it will not shake itself off the heating stand. After you have heated the lye solution for a sufficient length of time, examine the inside surface of the bottle of lye water. You will see that it has been etched where the caustic has eaten into the glass. This is the reason why the glass bottles containing caustic solutions that you keep on your chemical workbench for several months often develop "fish," which consist of particles of the compound formed by the action of the alkali contents on the glass.



One of the rubber caps sold for automobile gear levers makes a good grip for the pestle you use for mixing

ANYONE CAN PERFORM THESE Easy Scientific Tests

Why Yellow Sodium Lights Are Best for Highways

BECAUSE of an imperfection in the lens of the human eye, we see objects more clearly under a light of a single color, or one with a strongly predominating color, than under a white light containing many colors. You can observe this imperfection by covering half of one eye with a card and looking at a notch in another card which is held toward a lamp. One side of the notch will appear blue and the other reddish-orange. The lens of the eye acts as a prism, breaking the white light up into many colors. Since each color requires a different focus, the edges of objects seen under white light are not as distinct as they would be under, say, a yellow light.



This experiment shows how the eye breaks up white light into colors, making objects indistinct

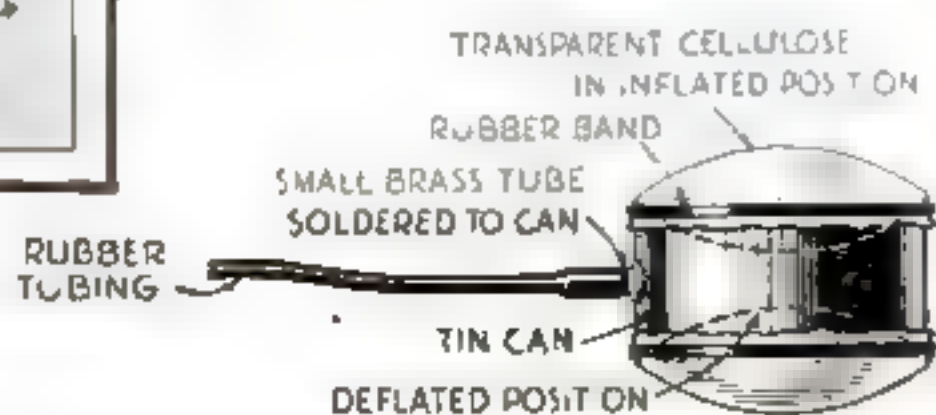
Air Lens Under Water Gives Strange Effect



Blown up to convex shape, the lens of air reduces the apparent size of the black strip laid on the bottom of the pan . .



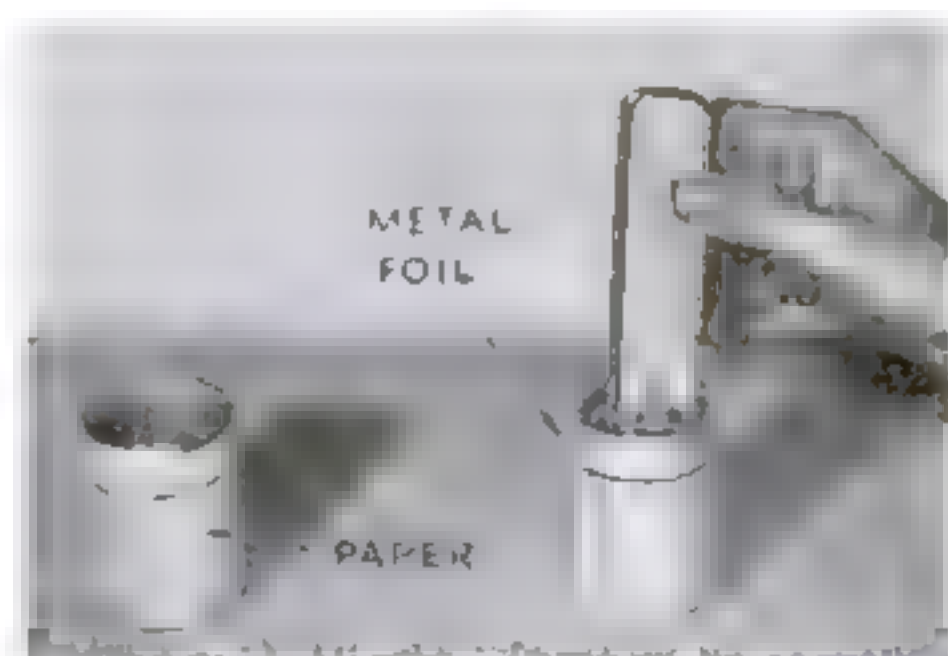
... but when air is sucked out to make the lens concave, it magnifies the strip. A glass lens does the opposite



You can easily make this underwater air lens with which to demonstrate an optical paradox

A LENS of air immersed in water has the opposite effect from a glass lens used in the air. Fasten disks of transparent cellulose loosely over the ends of a section of tin can and attach a rubber tube as shown in the drawing.

By holding the device under water, and blowing or sucking on the tube, you can make the transparent walls curve outward or inward. When the air lens is extended to convex shape, it will reduce the apparent size of a black strip placed on the bottom of the water pan. When the lens is concave, it will magnify the strip. This paradox is due to the lens being less dense than the medium with which it is surrounded reversing the conditions of a glass lens in air.



Metal as Heat Insulator

ALTHOUGH metal is known to be a better conductor of heat than paper, this experiment reveals it as a superior heat-insulating material. One glass tumbler is wrapped with paper, and another with aluminum foil such as is used to wrap candy. Fill each glass with boiling water and, after a few minutes, measure the temperatures. The water in the metal-wrapped glass will be considerably warmer. The shiny inner surface reflects heat waves, reducing radiation. This is why vacuum bottles have silvered surfaces.

Measuring Speed of Light in Water

LIGHT travels only three fourths as fast in water as in air. You can prove this by looking down into a glass of water and holding a pencil against the outside of the glass at the point where the bottom appears to be. As illustrated on the scale in the photograph at the right, the point is three fourths of the depth below the surface of the water. This apparent change in the position of the bottom is due to the bending of the light rays as they emerge from the liquid, which in turn is caused by the difference in the speed with which light travels through water and air.



Pencil shows where bottom of glass appears to be

Useful Ideas for Radio Fans



A fluorescent material on the plate shows action of electrons

Novel Test Unit Shows Principles Of Radio Tubes

AS AN aid in teaching radio-tube principles to radio beginners and experimenters, one manufacturer has devised the demonstration tube shown at the left. The filament, the grid, and the plate are arranged as large flat elements inside a clear glass bulb so that their construction and relative positions are evident to students. The plate, covered with a fluorescent material, glows when electrons streaming from the filament strike it. Changing the grid voltage by means of a control varies the amount of electrons, the effect being vividly illustrated by the varying widths and brilliancy of the glowing fluorescent bands on the plate.



Handy Insulating Bars Come in Three Sizes

WITH the large assortment of cut and drilled isolantite bars now on the market, even the amateur without a shop can make use of this high-grade insulating material. Sold in three different sizes, each supplied with four conveniently spaced holes, the bars are suitable for supporting low-loss coils, insulating variable condensers and other parts from a metal chassis, and separating the wires of antenna lead-in transmission lines. One type, provided with soldering lugs, is particularly useful for assembling high-voltage connection strips.

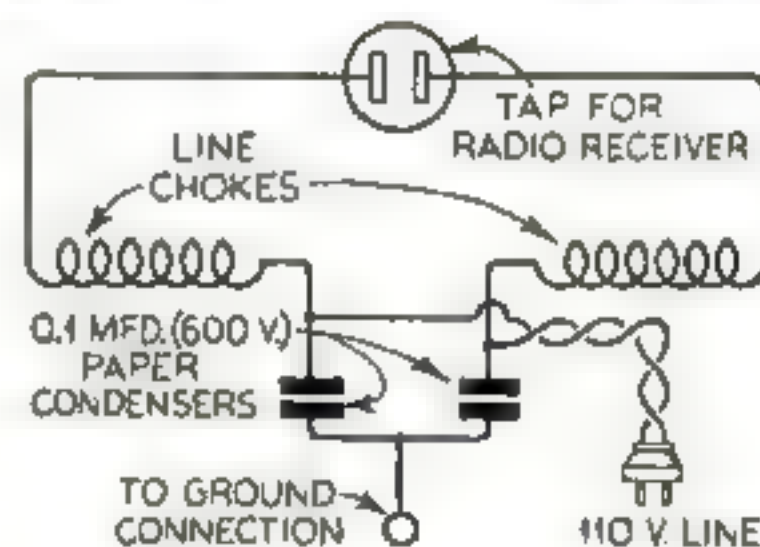
Storage Battery Gives Choice of Voltages

A NEW storage battery capable of giving either two or six volts will appeal to radio experimenters and owners of battery radios. It consists of three cells, and is equipped with two special connector bars by means of which the cells can be hooked up either in series to give six volts or in parallel to give two volts. The bars are secured in place by large thumb screws on the posts of the individual cells, and can be shifted in a few seconds.

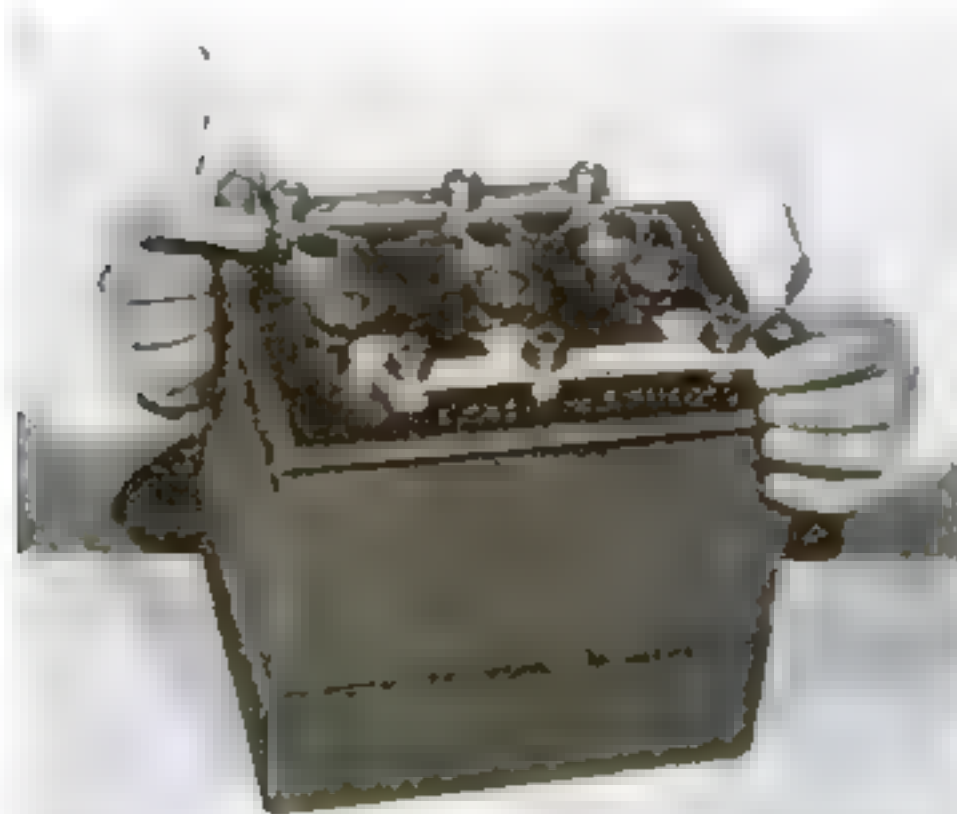


Noise Filter Easily Made With Special Line Choke

RADIO interference created by household electrical machines and carried into the receiver by the power line can be effectively reduced or eliminated by a simple noise filter consisting of two small fixed condensers and one of three sizes of special radio-frequency line chokes now on the market. The new chokes are double units, containing two separate windings on heavy insulated forms; they look very much like resistors but have heavier wire, since they are used in series with the radio-receiver power supply and must carry the full current load of the circuit.

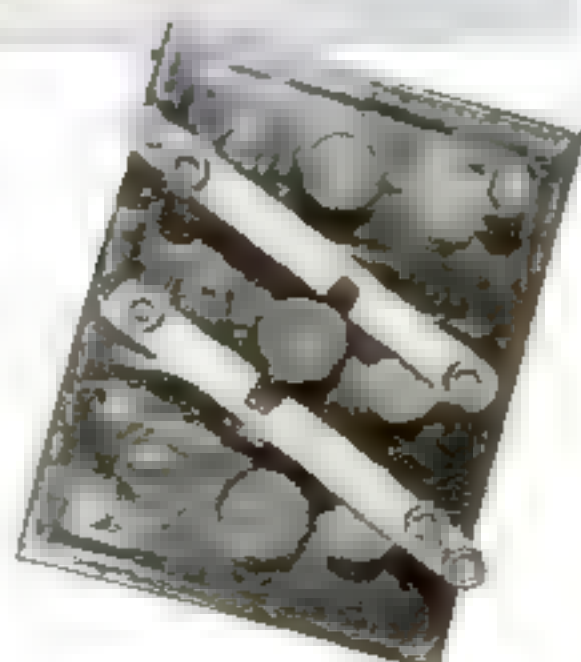


Connections for noise filter and, above, the simple unit made with two small fixed condensers and a special line choke. Three sizes of the new chokes are seen in the picture at left, above



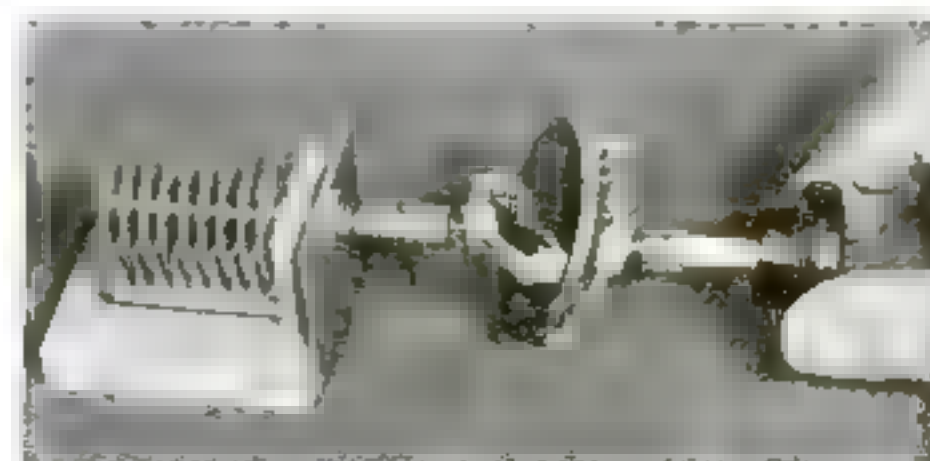
Special storage battery with its three cells connected in parallel

The battery with connector bars placed to link its cells in series



Flexible Coupler for Offset Control Shafts

A USEFUL device for coupling offset control shafts to dials and for isolating high-voltage variable condensers is the new flexible coupler illustrated. It consists of a disk of insulating material with hinged, U-shaped arms carrying bushings for quarter-inch shafts. The universal-joint arrangement permits control of a condenser up to ninety degrees out of line.



This coupler operates like a universal joint

These Kinks Simplify

BY MAKING use of a few inexpensive tools, and following simple rules, you can easily turn service man when a new circuit fails to operate or your latest home-built receiver falls short of expectations. Generally, the search will reveal some faulty part or some wrong connection that can be quickly remedied.

Hunting trouble in a radio circuit is largely a process of elimination. Once you have checked and rechecked the wiring to make sure that the original circuit diagram has been followed accurately, your problem consists simply of checking the parts one by one until the probable causes of the trouble are narrowed down to one or two possibilities.

Most simple receivers built by the amateur can be considered as consisting of four separate sections or divisions—the antenna and ground circuit, including the radio-frequency amplifier; the detector circuit; the audio amplifier; and the power supply. Each section develops its own characteristic troubles, and by recognizing the various symptoms as they appear you can reduce your trouble-shooting problems to nothing more than a step-by-step trail of clues.

In the antenna-ground circuit, there are various points other than the actual antenna and ground that should come in for consideration. For instance, a great many troubles can be traced directly to poor insulation of the antenna trimmer condenser in circuits using capacity coupling. Though this condenser may show perfect insulation from the chassis when checked with a continuity tester, the capacity effect through the insulation may be so large that the antenna is actually by-passed to ground. For this reason it is advisable to mount this condenser on small stand-off

insulators and attach an insulated extension tuning shaft to minimize hand-capacity effects.

In the radio-frequency stage, the troubles are few and are easily recognized. One of the commonest is overload. This is noticeable when the condenser is tuned to a station. First, the signal is broad each side of resonance, and when resonance is approached the signal becomes distorted and muffled. Installing the volume control in this stage will cure this.

Open by-pass condensers also can cause a similar blocking effect accompanied by a loss in gain and selectivity. Condensers used for radio-frequency by-passing should be non-inductive. Also, the ground leads from radio-frequency condensers must not be common to two or more capacitors.

Regeneration may also be experienced in this stage. This may be caused by having plate and grid leads too close together, or by applying incorrect voltages to the tube. The chief offender here is the screen voltage, which can be quickly checked with a voltmeter. A shorted bias resistor or

condenser can also cause this trouble, and should be checked.

Broad tuning is another common trouble, and often can be traced to a poor connection or an open by-pass condenser. When a ganged tuning condenser is used, the trouble may be from incorrect tracking. This is remedied by adjusting the trimmers or by bending one or two of the condenser plates.

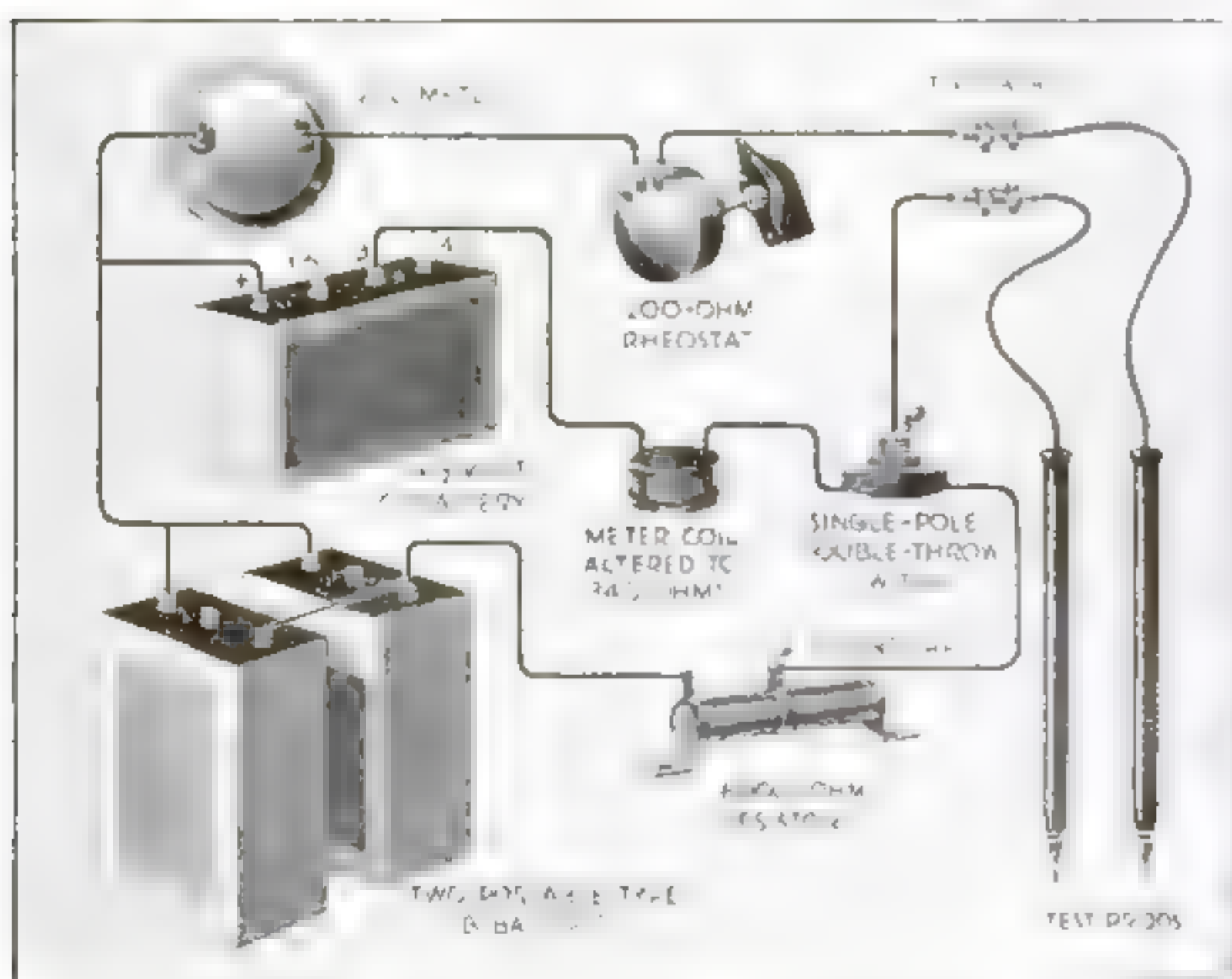
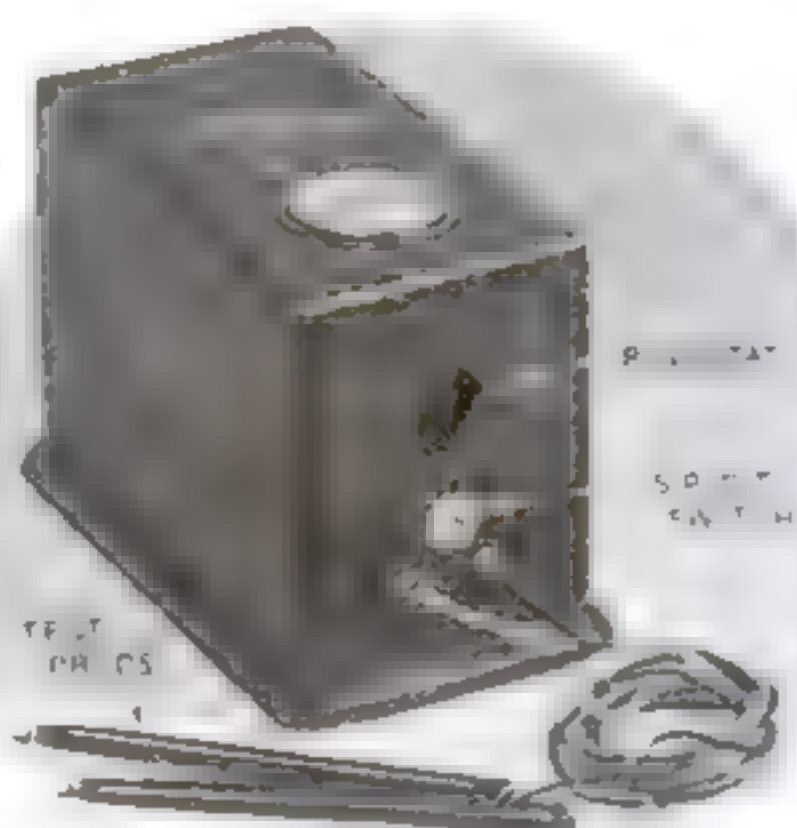
If, after checking these symptoms, the stage still fails to operate properly, check all common ground returns. Indiscriminate grounding to the nearest place on the chassis often is responsible for mysterious effects that show up as uncontrollable oscillation, tuning troubles, and general instability.

With due regard to all the other parts that go to make up the average receiver, the most important is the detector. Cranky regeneration can completely upset the operation of an otherwise perfect receiver. Generally, the main reason for lack of oscillation is incorrect polarity connections of the tickler winding to the plate of the tube and the positive side of the "B" supply. If the two windings are wound in the same direction, and if the start of the tuned (grid) coil goes to the grid, then the beginning of the tickler winding should go to the positive "B" lead. This is shown in one of the diagrams, together with the standard prong connections for four and six-prong plug-in coils.

Among the other causes of faulty regeneration that can be credited to the plug-in coils are insufficient turns on the tickler and too much spacing between the grid and tickler winding.

The by-pass condenser in the detector plate circuit is another component that influences the sensitivity and regeneration. In many instances, particularly with resistance coupling, the value is quite critical

By JOHN CARR

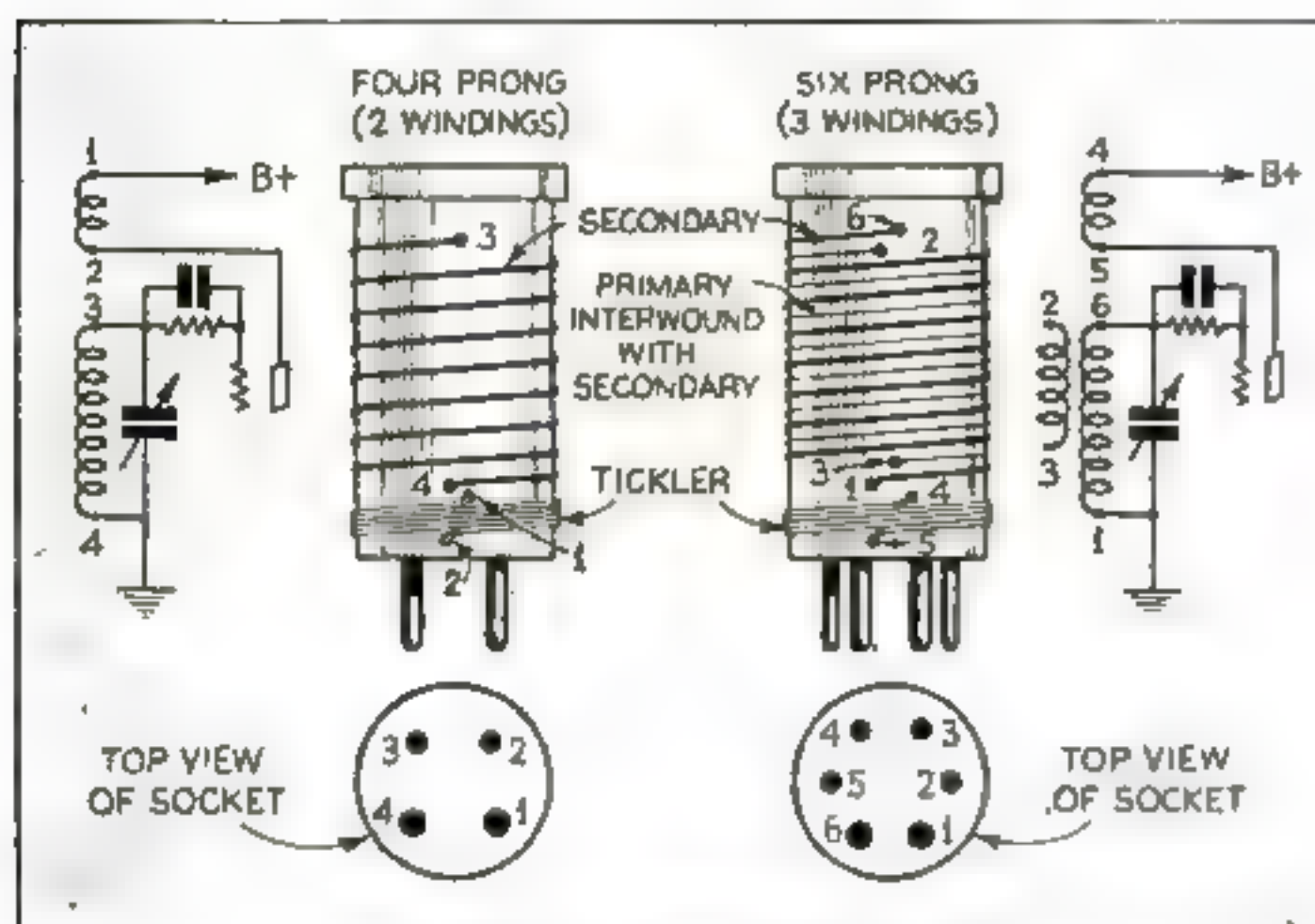


SIMPLE OHMMETER FOR TESTING RESISTANCES

From an inexpensive voltmeter you can make the handy ohmmeter shown in the circle. Note the control rheostat and switch. In the photograph at the right, the unit is seen in use, and the diagram shows the wiring. Batteries are housed in the meter box.



Radio Trouble-Shooting



CHECK THE WIRING ON PLUG-IN COILS

Trouble in short-wave receivers may be caused by reversed connections to the tickler winding on a plug-in coil. The diagram at the left shows proper connections for four and six-prong coils, for your guidance in checking this possible cause of failure

stage, the leads should be short and shielded.

Distortion often is caused by excessive regeneration. This is frequently due to faulty coupling between the various audio stages. Distortion from this condition asserts itself by a mysterious increase in volume at certain frequencies. If the degree of regeneration reaches a critical value, "motor-boating" will occur. This condition is easily recognized by the "put-put" sound, similar to that of a motor boat, that issues from the loudspeaker. To eliminate this trouble, it is necessary to install resistor-capacity filters in the positive "B" leads of the detector and audio plates. In addition to stabilizing the circuit, they aid materially in further reducing the hum. If impedance or transformer-coupling is used, these filters may be used in the grid circuits. Grid filters should not be used in resistance-coupled amplifiers, however.

Troubles in power supplies are the easiest of all to cure. First of all, overloading of the power transformer should be avoided, as this interferes with the regulation of the "B" supply, and the heat developed within the transformer may cause an insulation breakdown with a resultant short circuit. If a defect occurs in a power transformer, it usually has to be replaced.

The commonest trouble in power supplies is hum from a poor filter circuit. Overloaded and poor-quality chokes are mainly responsible for this. If the chokes are not saturated (overloaded), increasing the filter condensers will eliminate the ripple from the rectified direct current.

When a power supply is used with a short-wave regenerative set, the voltage regulation must be held fairly constant to prevent poor quality and troublesome fading. A bleeder resistor dissipating from fifteen to twenty-five milliamperes will help prevent this condition.

The phenomenon known as "tunable hum" (a hum that appears when the detector is

(Continued on page 127)

if smooth regeneration over the entire band is to be obtained. The size of the by-pass condenser used with the choke will depend upon the efficiency of the choke used. A fairly good choke requires a condenser ranging from .0001 to .00025 mfd. If the detector will not oscillate, and you suspect the choke, try substituting larger condensers up to .001 mfd.

One of the most exasperating detector troubles is a critical regeneration control. If regeneration is obtained by varying the screen voltage, a lower potential applied to the potentiometer will cure this. Voltages as low as ten volts may be necessary before smooth regeneration is obtained. Also, the by-pass condenser from the screen to ground should always be as large as possible.

Sensitivity and smooth control of regeneration also is dependent, to a large extent, on the size of the grid leak. The higher the value of the grid leak, the greater the sensitivity. However, if the resistance of the leak is too high, the grid will block. This is easily recognized by a periodic clicking heard in the phones or speaker when the regeneration control is advanced. The cure is obvious: lower the value of the grid-leak resistance. Values used for grid leaks vary from one to ten megohms. An open or intermittent grid condenser will cause the signal to become mushy, and sometimes a stuttering effect will be heard.

The troubles associated with audio amplifiers are more noticeable because they are within the response of the human ear. Regardless of the type of amplifier involved, of which there are three—resistance, transformer, and impedance-coupled—the troubles are similar. The principal difficulties are hum, distortion, and regeneration.

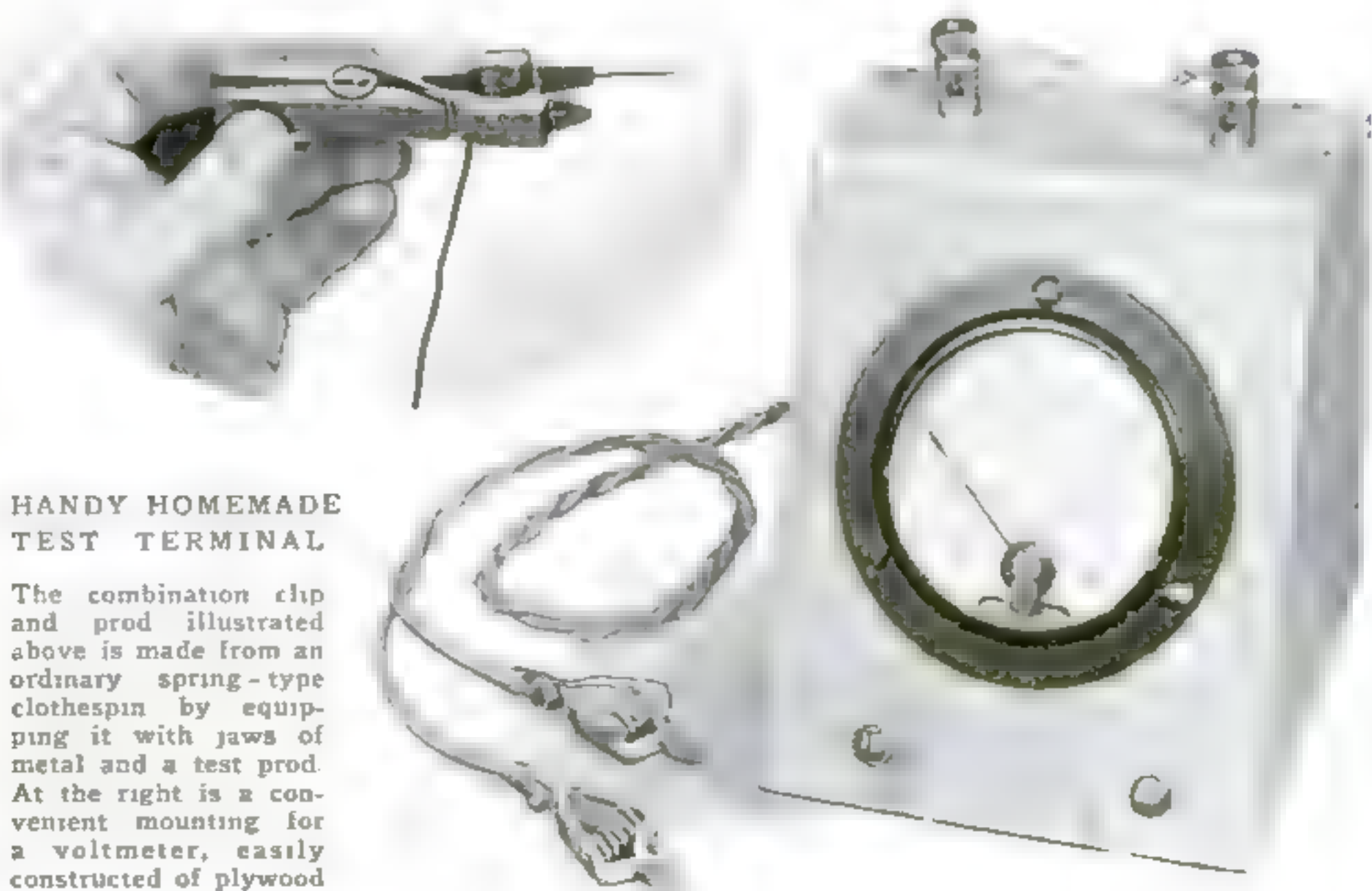
Hum from insufficient filtering of the alternating-current power supply will be disregarded here, as this unit will be fully

covered later. An open grid circuit will cause hum, and a careful check should be made for this cause, as this often eludes the experimenter. If the grid is open, there is no bias voltage on the tube. This can be tested by connecting a wire from the grid of the tube to the "B" minus terminal and inserting a voltmeter in the tube's plate circuit. If the grid is open, the plate current through the tube will decrease considerably when the circuit is closed through the connecting wire.

Hum also can be caused by induction from a power transformer. For this reason, keep the power transformer as far away from the audio tubes as is possible. When a volume control is used in an audio

HANDY HOMEMADE TEST TERMINAL

The combination clip and prod illustrated above is made from an ordinary spring-type clothespin by equipping it with jaws of metal and a test prod. At the right is a convenient mounting for a voltmeter, easily constructed of plywood



By MARTIN BUNN



"Now we'll just see about that piston," Gus grunted, as he applied the crank and turned the motor over. The compression seemed uniform

How's Your Air Cleaner?

HHEY, Gus!" Joe Clark poked his head out of his little office in the Model Garage to shout to his partner. "Doc Wisner is on the phone. He's burned out a bearing or something up on the bend in the road nearest to Mulberry River. He's up there fishing. Wants you to tow him in."

Gus Wilson, who took care of the mechanical work in the establishment, turned away from the car on which he was working and tossed a wrench into his tool kit.

"Up on Mulberry River, eh? All right, Joe, tell him I'll be up there right away."

Gus waited until Joe had stepped back into his office. Then, with a sly grin wrinkling the corners of his mouth, he reached into the bottom of his own car and quickly snaked out a fishing rod and tackle box, which he slipped under the seat of the tow car.

"Good old Doc!" he murmured, as the tow car rolled out of the garage. "The fish must be biting today. It's about time I had a go at them!"

But the smile disappeared from Gus's face as he rounded the last bend in the road. "Guess Doc really is in trouble," he muttered, as he pulled up behind a new sedan that had been driven a little way up a wagon track leading toward the river. A short, plump man in hip wading boots was bending over the raised hood and gazing disgustedly at the motor.

"Howdy, Doc," Gus called. "I was hoping you were fixing things so I could sneak an hour's fishing."

"That's just what I was going to do, Gus," Wisner grinned, "and then danged if the motor didn't go haywire! She's burned out a bearing or blown a piston or something. There's a terrible clank when you start the engine."

"Did it happen suddenly?" Gus asked.

"Sure did," Wisner replied. "I found the fish were biting fine, so I came back to the car, intending to drive to that house down the road and phone you. When I stepped on the starter, the motor roared like a mad bull and I had to stop it by turning off the ignition. Nearly scared me stiff. But the throttle didn't seem to be jammed, so I tried it again, and that time the motor started normally. As soon as I got it going, though, I heard a loud clanking noise. I shut it off right away and walked down to the house. Suppose we get in a bit of fishing, and then you can tow me in."

"That's a queer one," Gus grunted. "Motor raced, and now there's a clanking noise. It might be a burned bearing or a blown piston, all right, but then what made it race? Let me look at it a minute before we go down to the river. I'm kind of interested to see what caused that combination."

Gus reached into the car's tool compartment and pulled out the hand crank.

"Now we'll just see about that piston," he grunted, as he applied the crank and slowly turned the motor over. The compression seemed uniform on all cylinders. Then he bounced the crank against compression at several different points, but there was no trace of a thump.

"No telling whether you've cracked a skirt off one of the pistons," Gus observed, "but it's a cinch you haven't busted any piston heads. A little click or clank when you rock it against compression might come from the valve mechanism, but the fact that there isn't any noise at all is a pretty good sign that there's no burned-out bearing."

"Maybe it won't clank now," Wisner suggested, hopefully.

"I wouldn't take a chance," Gus decided. "It doesn't pay to run a motor if it is making any queer noises. Anyhow, I wouldn't want to start it without taking a look at that throttle. Perhaps the butterfly valve has come loose from the shaft."

Gus lifted off the air cleaner, and peered down into the carburetor opening.

"What the Sam Hill is that?" he growled, as he cautiously inserted a huge finger in the opening and fished out a thin, rough-edged piece of metal.

Gus turned the air cleaner over and examined it closely. "Well," he chuckled, "guess we might as well get in a little fishing, and then I'll tow you in. Here's the trouble. This inside flange on the air cleaner has broken—the metal must have had a flaw—and two pieces went down into the carburetor. Here's one of them. The other jammed the throttle open when it dropped loose, and then it got through into one of the cylinders. That's what is causing the clanking noise. I'll have to take the head off to get it out."

"I never could (*Continued on page 129*)

THE HOMEWORKSHOP



New boat, less than ten feet long, does twenty-two miles an hour with a light and inexpensive outboard motor...The hull is an easy one to construct



SMALL *Sport Runabout* PLANES OVER WATER AT THRILLING SPEED

By Willard Crandall
FROM A DESIGN BY
Bruce N. Crandall

HERE is something long desired in an outboard boat—a fast sport runabout less than 10 ft. long. This little boat will give extraordinary speed with low-power outboard motors. With a 4-h.p. motor, it will make up to 22 m.p.h., and with a class-A motor, it is capable of hitting the high mark of 40 m.p.h. In spite of this, it is a complete, comfortable runabout for one or even two persons—not a racing boat or a freak design.

The unusual qualities that make the boat plane with a 4-h.p. motor are the result of years of experience in designing and building boats of the hydroplane type. Heretofore the motors in the lightweight class—4-, 6-, and 8-h.p. motors—have not given much speed simply because they lack the power to make ordinary runabouts plane. As these small motors are inexpensive to own and operate, it is possible, by building the new runabout, to obtain thrilling speeds on the water at much less than the customary expense and with very little gas consumption.

Not only does the boat plane quite readily, but it turns sharply, as the double-beveled chines prevent any catching or tripping on the water. Another feature is its level-riding design, which gives it an attractive appearance and, of course, results in superior speed because all unnecessary drag in the water has been eliminated.

Although no boat of this size is suitable for large, open waterways, this runabout will ride the chop of inland lakes with little discomfort to passengers; and because of the beveled chines, it is difficult to upset.



Complete set of frames, including the assembled transom and transom frame

Any motor from 4 h.p. up to 65 lb. in weight may be used. The construction has been kept as simple as possible without sacrifice of looks, lightness, or performance. The over-all length is 9 ft. 8 in.; the beam, 43 in.

The ideal materials for making the boat as light as possible without loss of strength are red or white cedar for the planking and spruce for the entire framework. The spruce should all be straight grained and free from knots. With the use of these materials in the sizes specified in the list on a following page, the boat will weigh only slightly more than 100 lb. complete. The total cost should not be over thirty dollars, including all fittings, but this will vary a great deal in different localities.

Philippine mahogany is also an excellent material for use in planking; it is stronger but somewhat heavier than cedar. It may also be used for the framework if spruce is not obtainable. In the list, various other materials are given in the order of their suitability.

All screws and bolts should be flathead brass except where otherwise specified. If, however, the boat is to be used in fresh water only, galvanized iron screws may be substituted to reduce the cost.

Before starting construction, it will be necessary to draw a set of full-sized patterns of the transom, frames, and stem. Take a sheet of wrapping paper the right size for one of the assembled frames and fold it in the mid-

dle. The fold will represent the center line. Draw the water line at right angles to the center line, and draw in the side and bottom frames according to the measurements given in the drawings. When this is done, punch holes through the paper at the important points, unfold, and draw the other half. The patterns for the deck frames may be drawn with a compass made by tying a long string to a pencil.

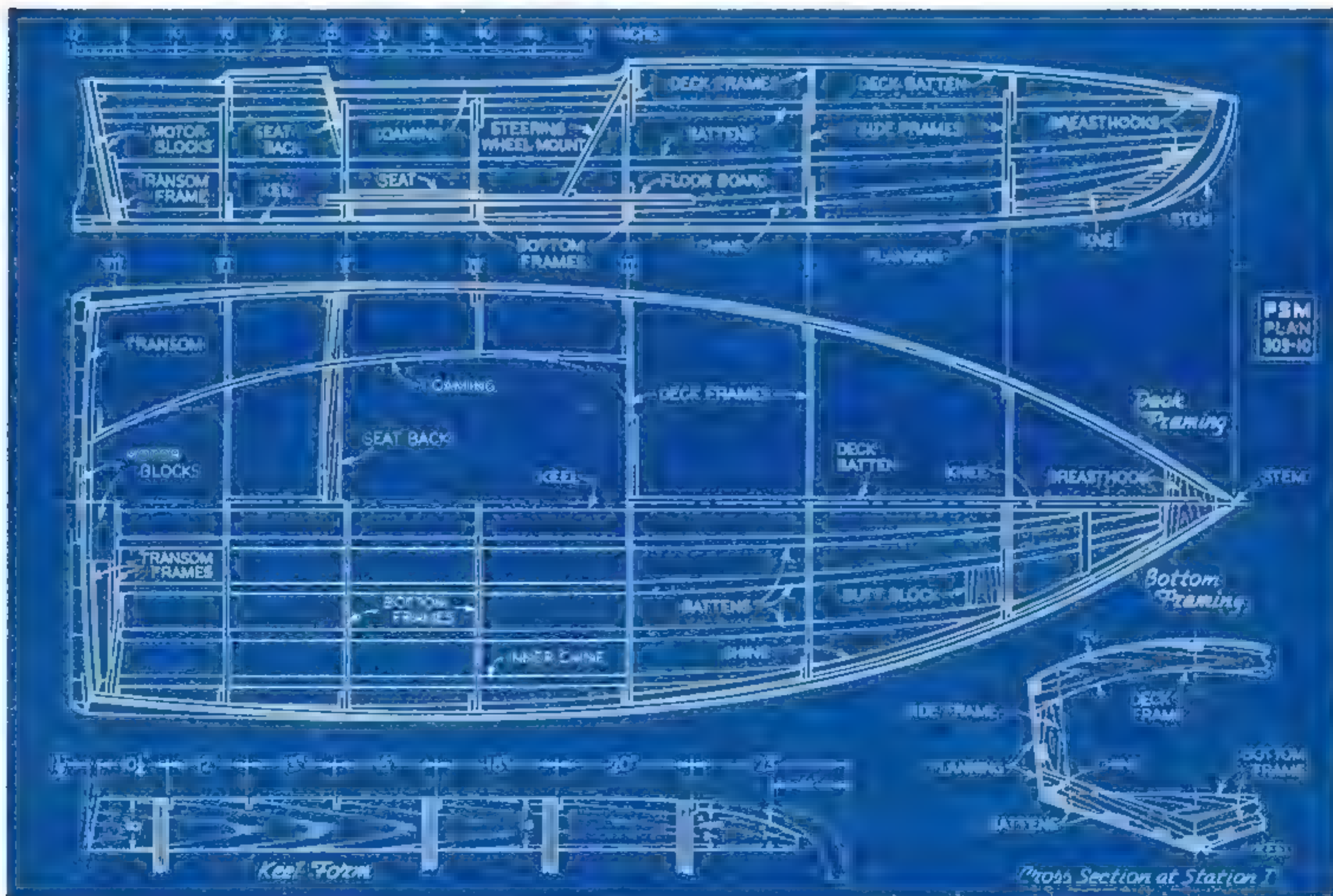
It will not be necessary to use the table of offsets unless it is



Construction of the framework at the stern. The chines and battens are cut down to about $\frac{1}{4}$ in. thick where they are notched into the stem in order not to weaken it by having to make deep notches



How the frames are set up on the keel form. All the upright supports must be perfectly plumb and rigid



Assembly drawings of the runabout with a scale in inches; a cross section at station I; and the keel form, drawn smaller but fully dimensioned



In order to get a true curve and proper angles for beveling the chine, use a batten as at left

The forward part of some of the bottom battens must be wrapped in rags and soaked with hot water before bending



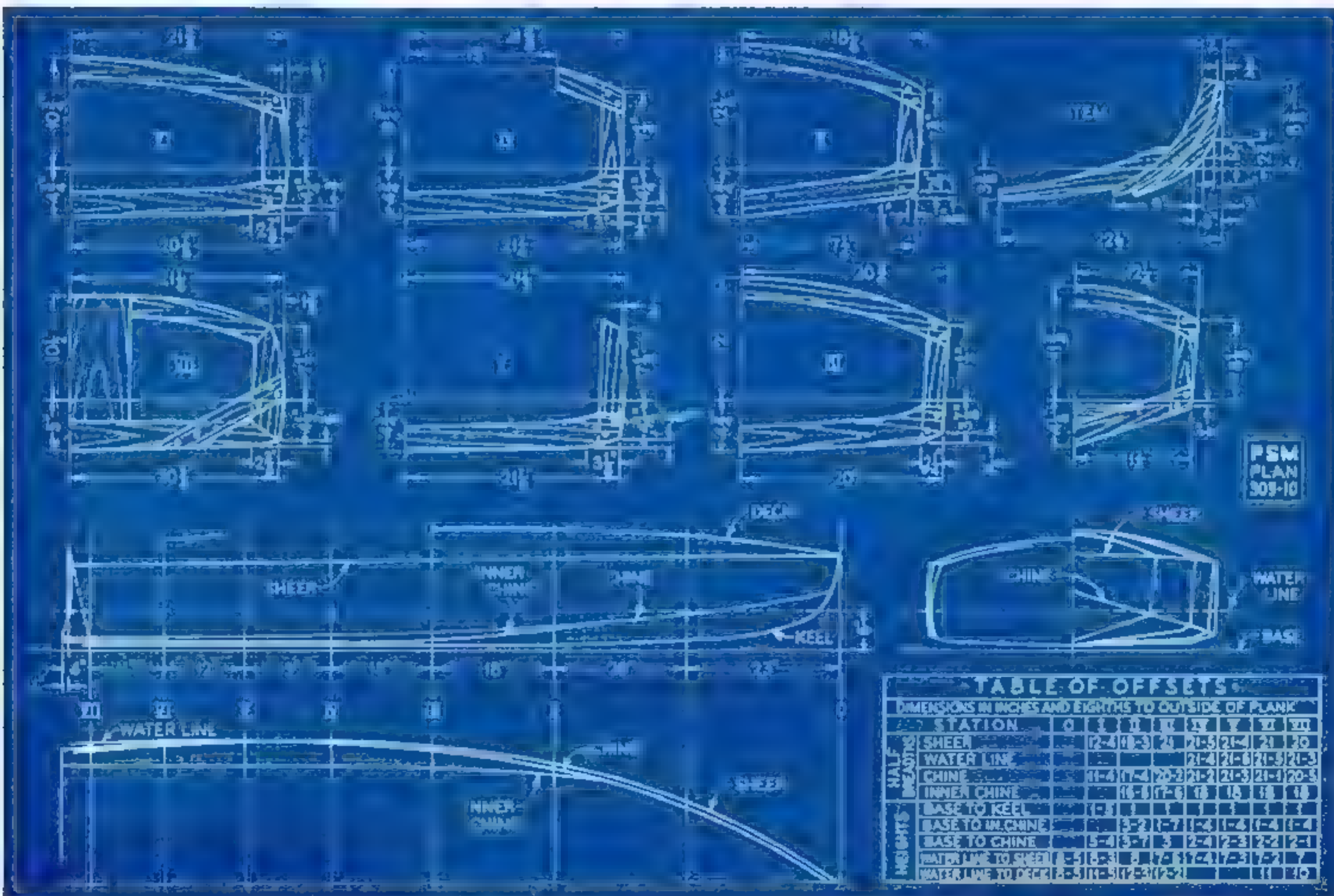
desired to lay out the entire boat full size before making the patterns.

To lay out the frames from the patterns, place each pattern over the frame material and punch through with a marking wheel. The frames can then be sawn out and planed to shape. Side frames Nos. 1, 2, and 3 and bottom frame No. 1 may be cut from a straight 2-in. board. All bottom frames but No. 1 can be made in one piece. Deck frame No. 3 will be made in two pieces. Notches for the keel can be cut at this time into the bottom frames, including the transom frame but not the transom. Mark the center line on all deck and bottom frames.

As a final check, place the frames over the patterns while fastening them together. Fasten at each corner with two bolts (such as 1½-in. No. 10 machine screws) or with copper rivets. The bolts or rivets will have to be set in more in the forward frames, to allow for beveling. The transom frames and motor blocks should be cut out as shown in the drawings, and the transom screwed to them with ¾-in. No. 7 screws. The motor block and other uprights behind the transom can be screwed through with 1½-in. No. 8 screws. Coat the surfaces to be joined together with marine glue before fastening.

The stem and knee should be cut from a piece of 1¼-in. spruce and shaped as shown. The exact angles of the stem and rabbet can best be determined after the stem is in position. Fasten the stem knee to the stem with 2-in. No. 10 screws.

The boat should be built upside down on a framework supported from the



Dimensioned drawings of frames and stem, the table of offsets, and design layout. The table need not be used unless a full-size drawing is desired

floor or from two timbers as illustrated in the photographs. The essential part of the framework is the keel form on which the keel, stem, frames, and transom will rest.

Cut the keel form from a 1 by 8 in. by 9-ft. plank according to the measurements given in the drawings. Nail it to the uprights at stations 1, 2, 3, and 6, and set it up and brace it as shown in the photographs. The uprights must be perfectly plumb and at right angles to the keel form. Cut the notches for the frame to the depth of the frame less the keel thickness, so that the keel notches in the frames will come flush with the form. The frames can be set in the notches of the form and then bolted to the uprights with one bolt through each deck and bottom frame. Care should be taken so that the center line of each bottom frame is placed at the exact center of the form. Deck frames can be

centered by putting them in such position that each center line is the same distance from the uprights as are the center lines of the bottom frames.

The keel, stem, and stem knee may now be set up in place. Screw the keel to the stem knee, frames, and transom frame with 1½-in. No. 8 screws. Fasten the stem in position with temporary braces to the floor. Notches for the chines and inner chines may be cut at this time, but first clamp a batten in place to make sure of getting a true curve and the proper bevels.

If not already done, the stem may now be dressed down to the proper shape, and the rabbet cut to the thickness of the planking. Cut the chine pieces down to a thickness of about ¼-in. at the point at which they are notched into the stem; deeper notches would weaken the stem. The same applies to the battens, which are notched into the stem later in the construction. Cut no notches into the transom itself, but only into the transom frame.

Great pains should be taken to bevel and, as ship-builders say, "fair" the chines, inner chines, keel, transom, and stem so the planking will fit perfectly. A light batten is laid over the frames for testing



Framework assembled on form. The beauty of line can be judged by the photograph at the left above

Screw the chines to the stem, frames, and transom frame with 1¼-in. No. 7 screws. Fit the breasthook between the two chines at the stem as shown and fasten the chines to it with 1½-in. No. 8 screws. Bend back together to prevent pulling stem out of line. Clamp them in position and see that they are in a true curve before fastening to frames.

Fasten the inner chines to the chines, frames, and transom frame with 1¼-in. No. 7 screws. Bevel and fair the chines, inner chines, keel, transom, and stem.

The battens can be put in now, or as the planking is fitted. There will be three bottom battens on each side of the keel. They should be placed so that all planks will be the same width at the transom. Take particular care to get a true curve on the top side batten (the sheer line).

Fasten the battens with 1¼-in. No. 7 screws. The forward part of some of the bottom battens will have to be steamed. Wrap the part to be bent with rags and then soak the rags with boiling water.

(TO BE CONCLUDED)

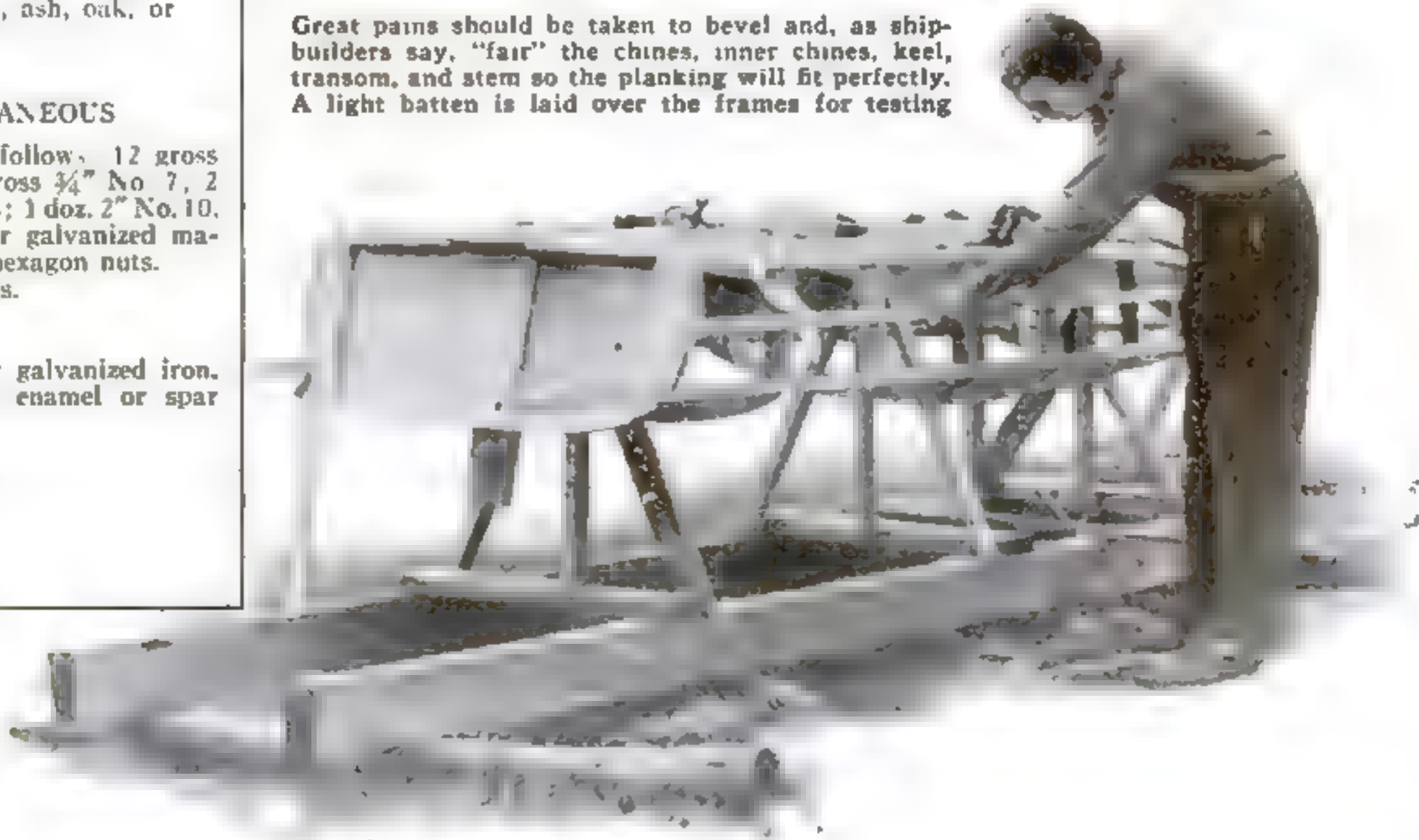
List of Materials

Note: Materials are listed in order of preference.

For	No. Pc.	Size	Material
Planking, decking, transom	22	5/16" x 6" x 10'	White cedar, red cedar, Philippine mahogany, spruce, cypress, or white pine
Frames, transom frame, motor blocks, deck beams	5 2 1	1/2" x 6" x 10' 1/4" x 2" x 10' 1/2" x 8" x 10'	Spruce, mahogany, cedar, white oak, fir, maple, or yellow pine
Keel	1	3/4" x 1 1/4" x 10'	Spruce, mahogany, cedar, fir, or yellow pine
(Or use	1	5/8" x 1" x 10'	White oak)
Chines, inner chines	4	3/4" x 1" x 10'	Spruce, mahogany, cedar, fir, or yellow pine
(Or use	4	1/2" x 1" x 10'	White oak)
Battens	10	1/2" x 1" x 10'	Spruce, mahogany, cedar, fir, or yellow pine
Stem, knee, breasthook	1	1 1/4" x 6" x 2 1/2'	Spruce, mahogany, white oak, or maple
Fender and sheer molding	2	1 1/2" half-round, 10' long	Maple, ash, oak, or pine

HARDWARE AND MISCELLANEOUS

Flathead brass or galvanized screws as follow: 12 gross 3/4" No. 6; 3 gross 7/8" No. 6; 1 gross 3/4" No. 7, 2 gross 1 1/4" No. 7; 3 doz. 1 1/2" No. 8; 1 doz. 2" No. 10. 1/2 gross 1 1/2" No. 10 flathead brass or galvanized machine screws and 1/2 gross No. 10 hexagon nuts. 3 doz. 1 1/4" No. 6 oval-head brass screws. 1 qt. marine glue. 3 yd. cotton flannelette. 2 ft. 3/8" half-oval brass, aluminum, or galvanized iron. 1 qt. priming coat and 1 qt. marine enamel or spar varnish. 1 deck cleat, 2". 1 outboard steering wheel (aluminum). 16 ft. 1/4" tiller rope. 2 pulleys, 1/4". 1 outboard fin, 2 1/2" x 6" or larger.



Constructing Novelties from Drapery Rods

IF YOU wish to make decorative novelty furniture that requires few tools, can be quickly put together, and costs but little, try assembling drapery cranes, brackets, rods, and finials of the type obtainable at ten-cent stores and from dealers in drapery supplies. The accompanying sketches suggest a few of the many novelties you can assemble from these materials.

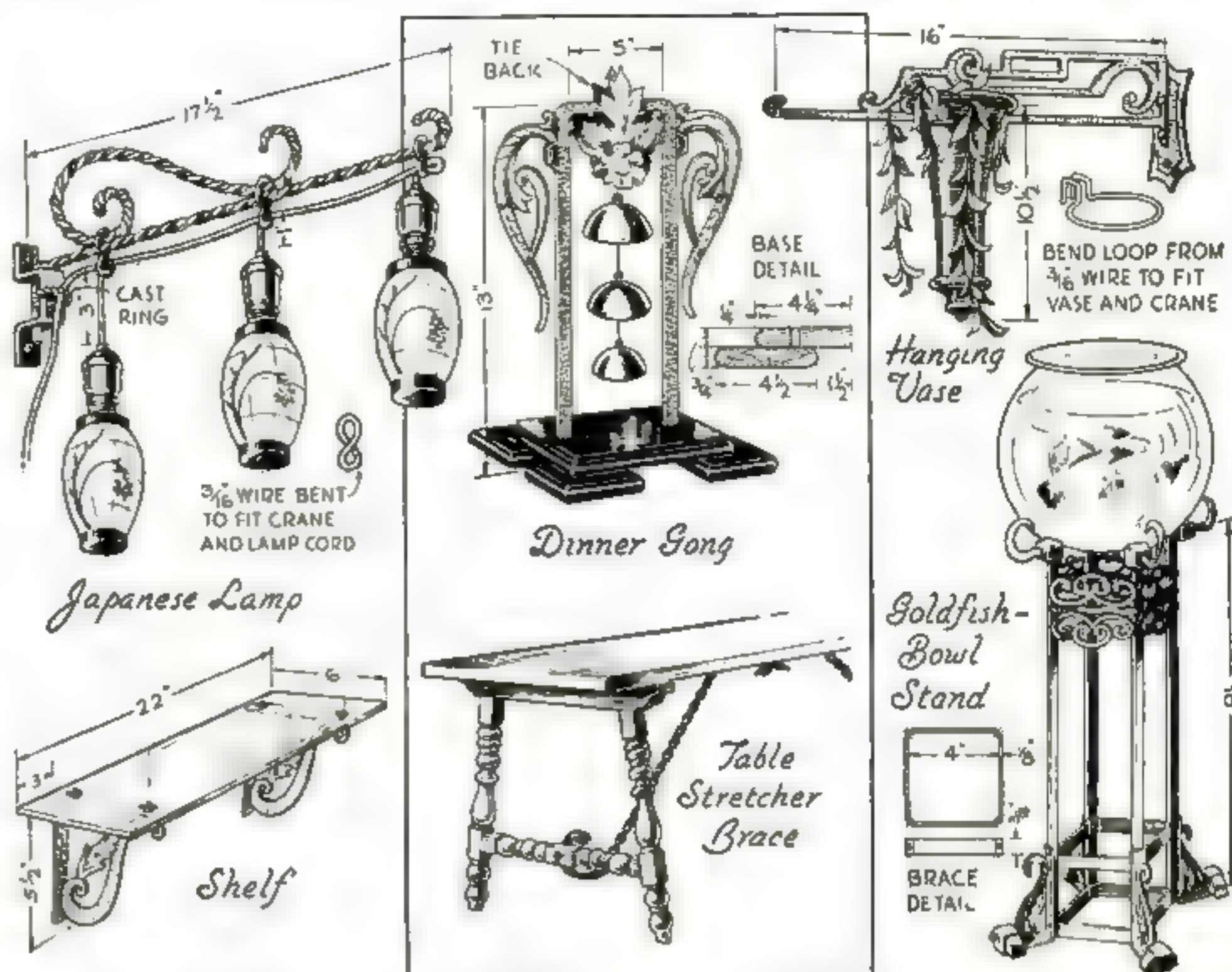
The hanging vase is an automobile accessory attached to a drapery crane by means of a heavy wire loop bent to clasp the vase below the bell top, with square loops to fit the iron rod.

The shelf consists of a piece of plate glass bolted to a pair of iron brackets and attached in any suitable location. Handsome window cupboards or gardens can be made by using longer shelves, the brackets being screwed to the casings. Glass shelves can be purchased ready-made.

The dinner gong stand is made by mortising two crane ends into a wooden base, enameled black. The bent-over pivot ends forming the top are held by two metal tie backs, bolted together. Hang the gong set from these.

Light globes shaped like Japanese lanterns are the basis of the crane lamp. Hang the sockets from their cords, and the supply cord from wire loops bent into figure 8's.

The goldfish-bowl stand is assembled from four straight, heavy rods, four cast curtain-rod ornaments, four scroll finials at the top, and four inverted brackets for feet. Three strap-iron braces, two below and one behind the top ornaments, are



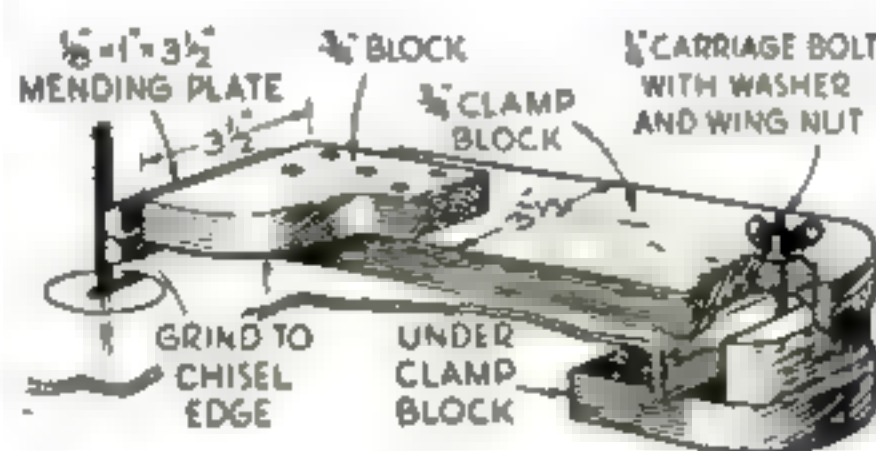
Craftwork suggestions for utilizing inexpensive drapery cranes, brackets, rods, and ornaments

drilled to take screws through the legs and the foot brackets. Fit hardwood blocks into the bracket clasps.

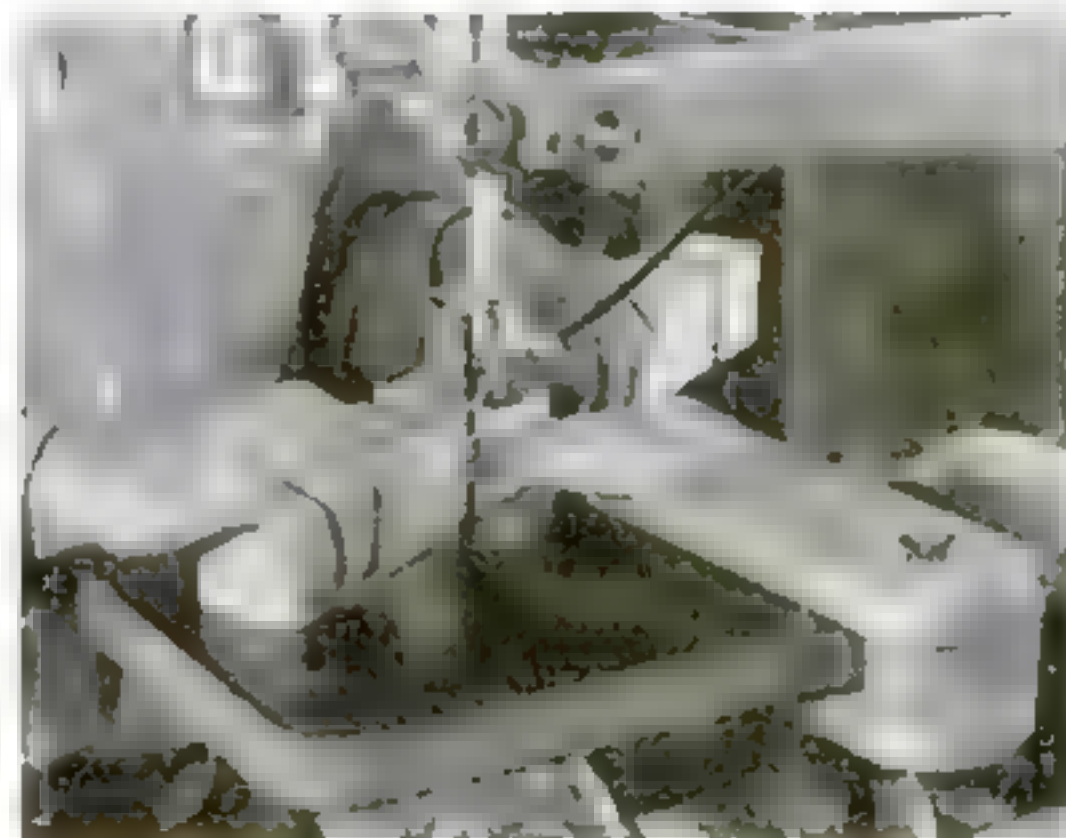
Small tables of Spanish type can be braced in true Spanish fashion with bent

irons from cranes, the upper scrolls being secured to the underside of the top with loops bent from strap iron, while the lower ends are held to the stretchers with threaded eyebolts, nuts outside.—L. K.

SCROLL SAW USED FOR SPECIAL JOBS



THE making of square table or chair legs with carved beads running around them is a problem to the average home mechanic. He has no molding cutters that will cut the double quarter-round V-grooves across the grain, and must either make them by hand or depend on shaping them with the band or scroll saw. The great disadvantage with the latter method is that the blade tends to bulge outward on the curve, producing a barrel-shaped cut in-



A guide for supporting a scroll-saw saber blade

stead of the cylindrical one required.

One photograph and the drawing illustrate a guide that will hold a scroll-saw saber blade straight. For use with the band saw, substitute a hardwood guide for the metal one, as the iron guide might case-harden and break the blade.

To shape the legs, score the grooves to depth on the circular saw, or lacking this, on the band or scroll saw. Then set up the guide and pare the bead ends round. The cuts are filed and sanded smooth.

Pieces having irregular outlines can be efficiently smoothed on the scroll saw by substituting for the saber blade a fairly coarse-toothed half-round file, as in the photograph at the left. A variety of files may be used in this way, if they are broken off to the proper length and the shanks are ground to a suitable shape.—O. V.



Irregular shapes are smoothed with a file

LATHE SPEEDS STAMPED DIRECTLY ON PULLEYS

ON LATHES and other machines where a constant shifting of speeds is necessary, it saves time to stamp all the pulley speeds on the pulleys themselves as shown above. If a machine has two speeds, such as a back-gear lathe, stamp the direct drive on the pulley and below it mark the speed in back gear. Because of the curvature of the pulleys, rock the numbering stamp back and forth in order to get a good impression.—BURL KNUTSON.

Woodworking Projects

FIREPLACE IMPROVES AN APARTMENT



This portable fireplace gives a homelike atmosphere and also provides extra storage space in the upper compartment



The fireplace from the back, showing shelf, hinge strip and its brace, and metal fire box

DESIGNED to give a cozy, homelike atmosphere to the living room of a small apartment, this portable fireplace also provides additional storage place. When raised, the hinged mantelshelf reveals a hidden shelf the full length of the upper section. Commercial fireplaces of this type are generally 4 ft. wide and 4 ft. high, but this one was built wider.

White pine with some sound knots is used. Cut the pieces, notch the two sides to fit the baseboard, nail the front crosspiece to the two sides, and attach the front uprights and the shelf and hinge strip. To hinge the lid, the author used a

12-in. length of piano hinge from an old radio cabinet, and inserted a 6-in. wide board between the hinge strip and the shelf to serve as a brace.

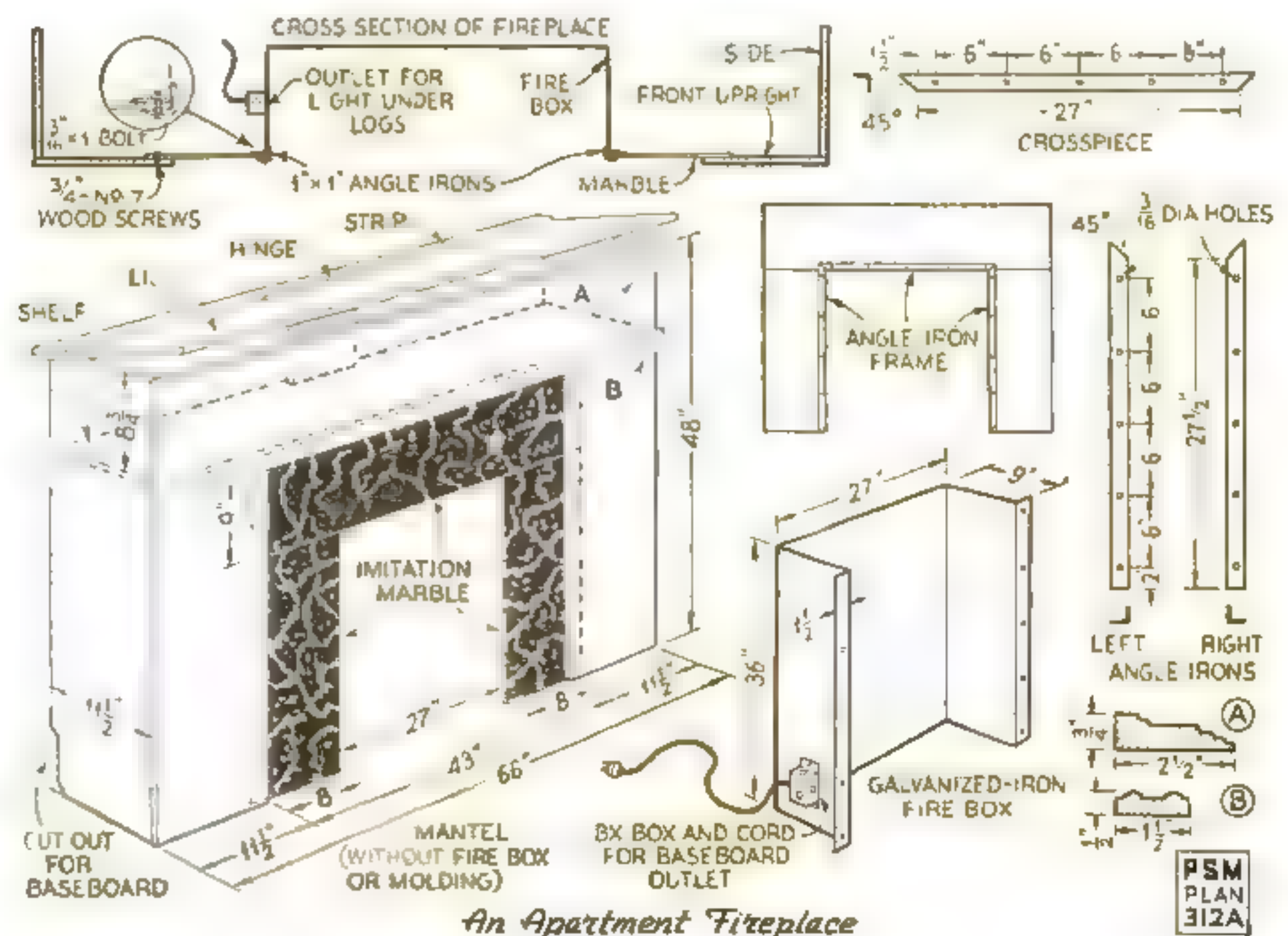
The "marble" is cut with a handsaw from a standard 4 by 4-ft. panel of pressed composition wood having a marble surface. Imitation brick might be used instead.

Half a standard 3 by 8-ft. sheet of galvanized iron is used for the fire box. A BX outlet box and baseboard type of outlet can be attached as shown for an electric log or a small radio. In this case another outlet was placed on the hinge strip back of the hinge for an electric clock. The fire box is set directly back of the marble front, three pieces of angle-iron are cut and drilled as indicated, and these are

bolted on in such a way that the marble is between them and the fire box.

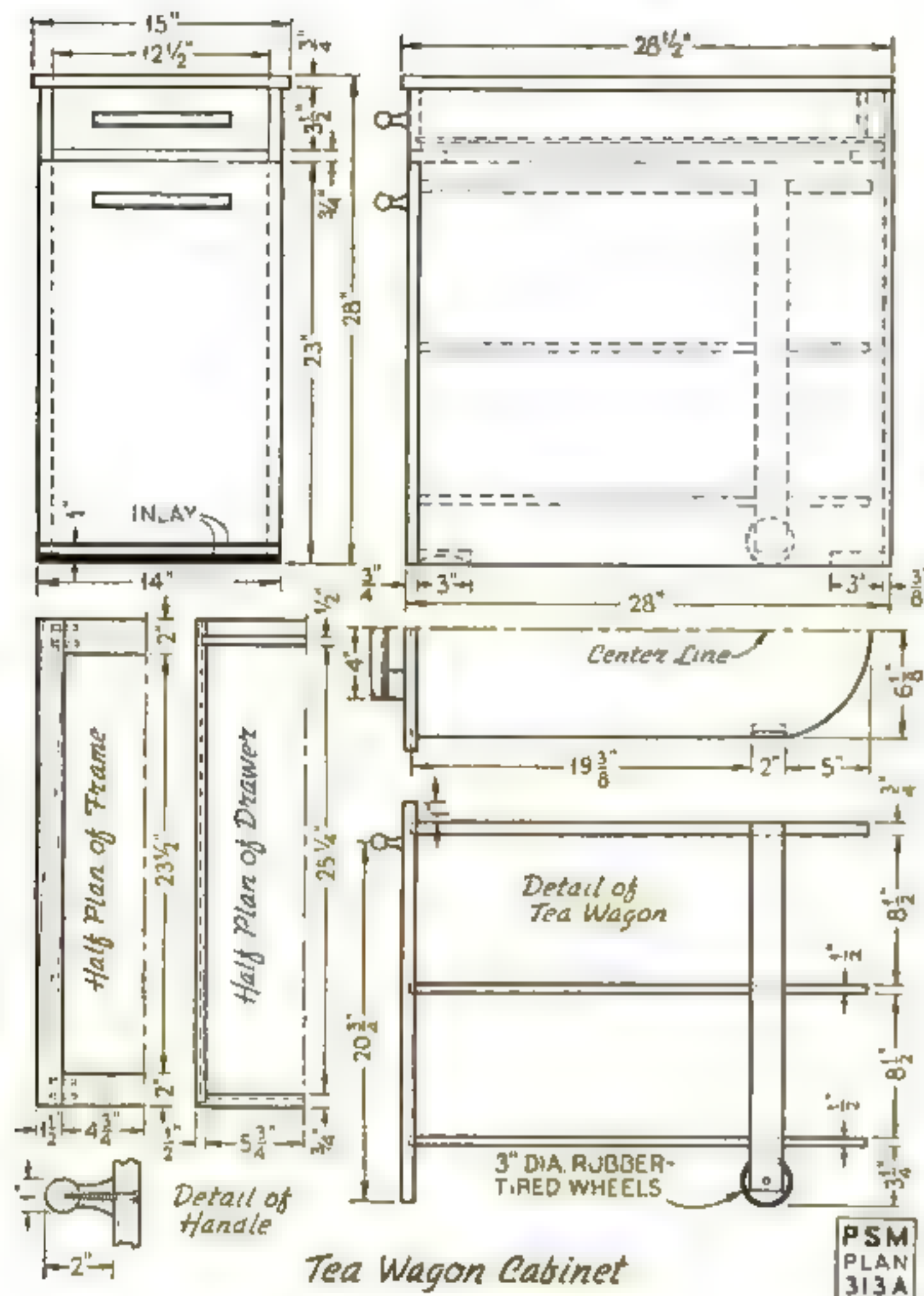
Trim the fireplace as desired. On the one illustrated, molding and two composition wood plaques were used.

For an enamel finish, sand the wood well, coat all knots with shellac, apply a coat of flat white, fill all nail holes, and apply two coats of enamel. For a stained finish, use one or more coats of oil stain, brushed on liberally and then wiped with a clean cotton cloth until the desired shade has been obtained. Finish with several coats of varnish. The fire box may be painted buff or French gray, and the angle-iron frame, dull black. For the hearth, linoleum or tile, stone, or brick design may be used.—CARL F. H. SCHRADER.
(For list of materials, turn to page 116)



An Apartment Fireplace

to Make for Your Home



Cabinet with tea wagon in place and details of frame, drawer, and wagon.

ALTHOUGH handy for serving refreshments, a tea wagon is inconvenient to store in a small home. This disadvantage may be overcome by constructing a cabinet into which the tea wagon may be pushed when not in use.

The cabinet sides, which may be either

plywood or boards glued together, are rabbeted on the rear edge for the $\frac{3}{8}$ -in. back and are joined by means of a frame and two bottom braces, which are doweled to them. Two grooves are cut across the bottom front brace as shown for the tea-wagon wheels.

The tea wagon is of modern design and may be of plain wood or veneered. In the latter case, the front of the silver drawer in the cabinet also should be veneered;

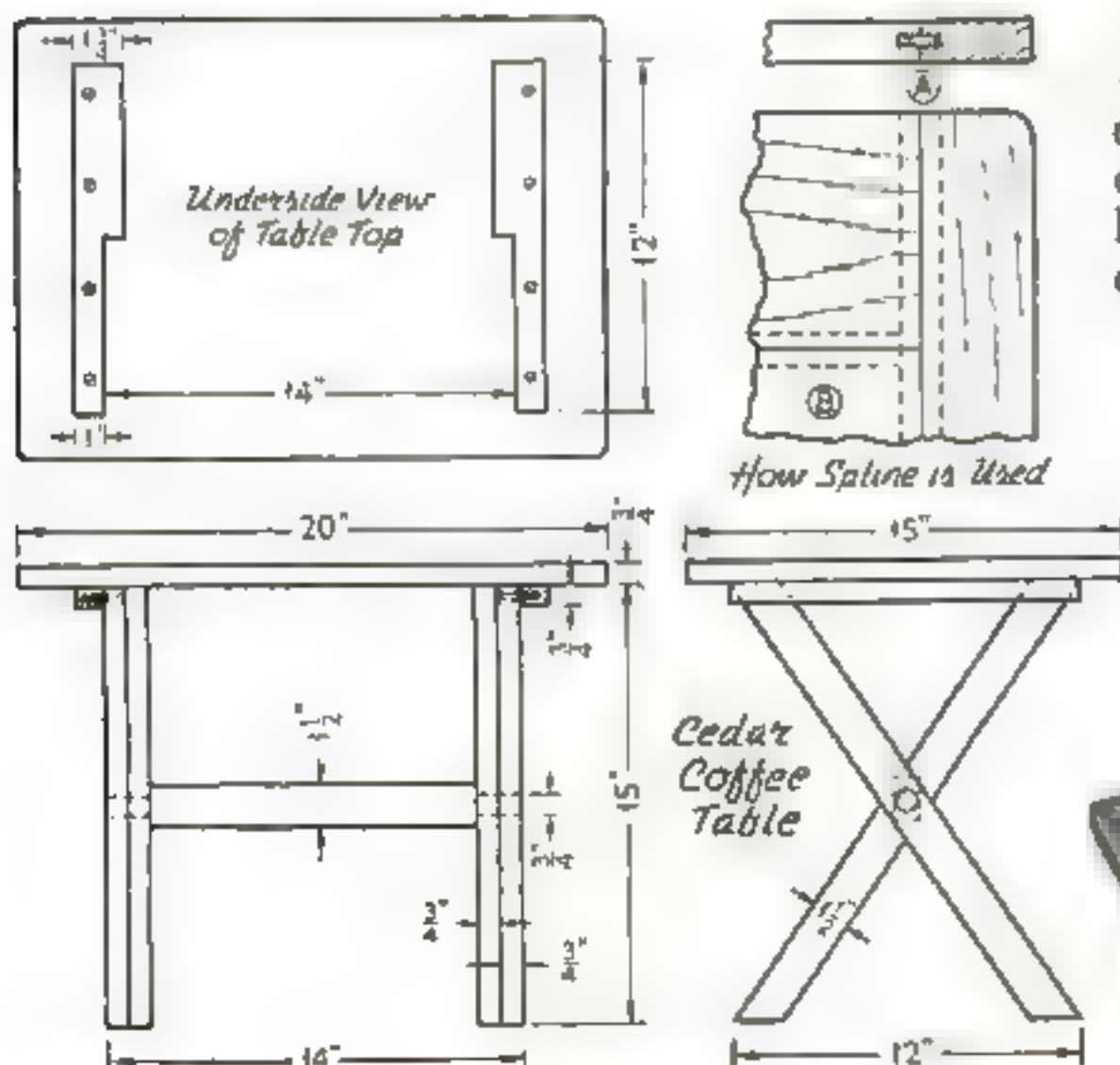
MODERN TEA WAGON ROLLS INTO ITS OWN CABINET

and two lines of black inlay add to the appearance. The shelves are joined to the front of the wagon by stopped dado joints—grooves cut across the grain of the wood but not carried all the way out. The legs are notched flush into the shelves. The wheels may be turned or bought ready-made. The handles are either made from 1-in. dowel rods or turned, and are finished to contrast with the cabinet.

If a cabinet wood is used, it may be left in the natural color or stained to match other furniture and finished with clear lacquer or varnish.—HERMAN HJORTH.

(For list of materials, turn to page 116)

COLORFUL COFFEE TABLE BUILT ENTIRELY OF RED CEDAR



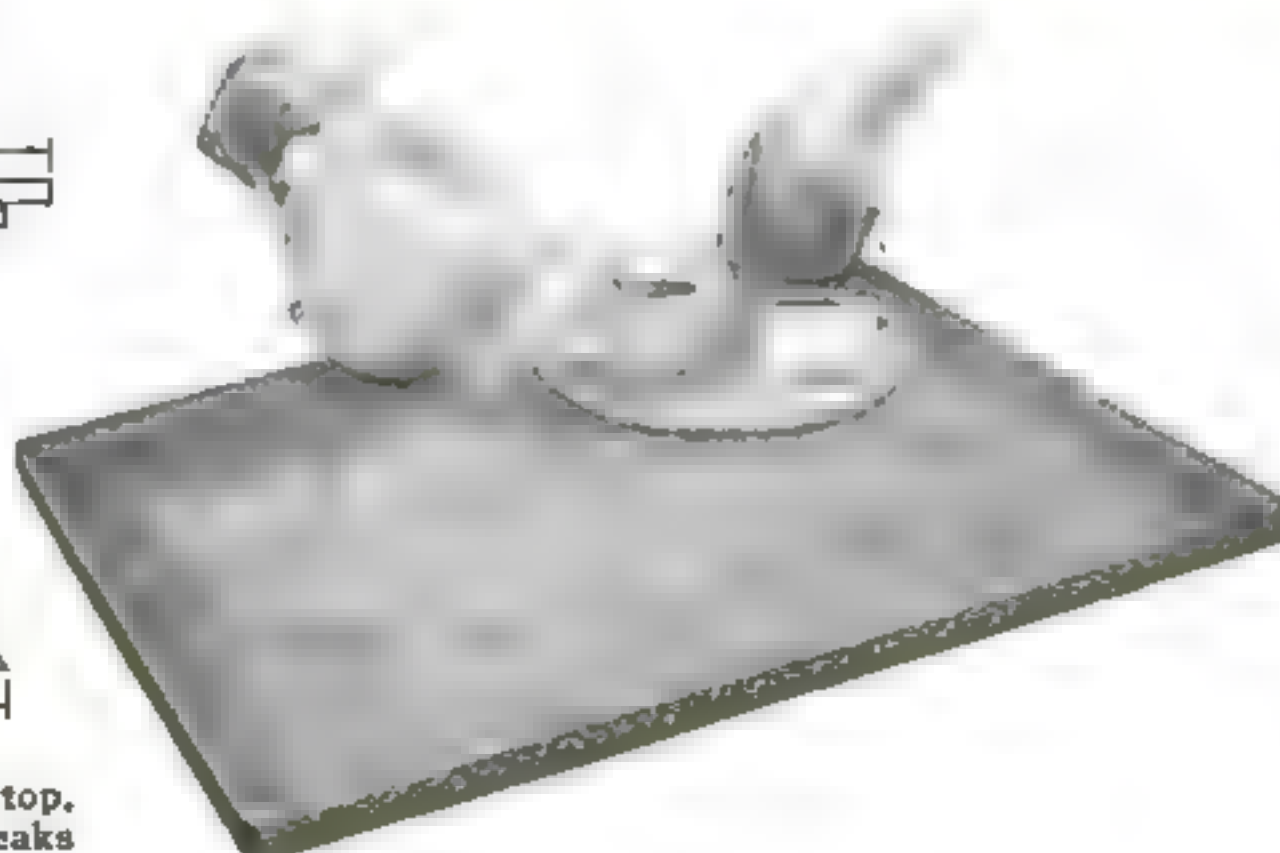
How the coffee table is constructed and, at right, the top, beautifully embellished with knots and light-colored streaks

LIVING rooms with the usual dark-colored furniture can be brightened by the addition of a red cedar coffee table. The wood itself is so beautiful that the simplest possible construction may be used—a rec-

tangular top on legs of the trestle type.

Cedar lumber usually comes in random widths. I cut a $\frac{3}{16}$ -in. groove in the edges of the $\frac{3}{4}$ -in. thick material with the dado attachment on my bench saw and glued the pieces together by using splines

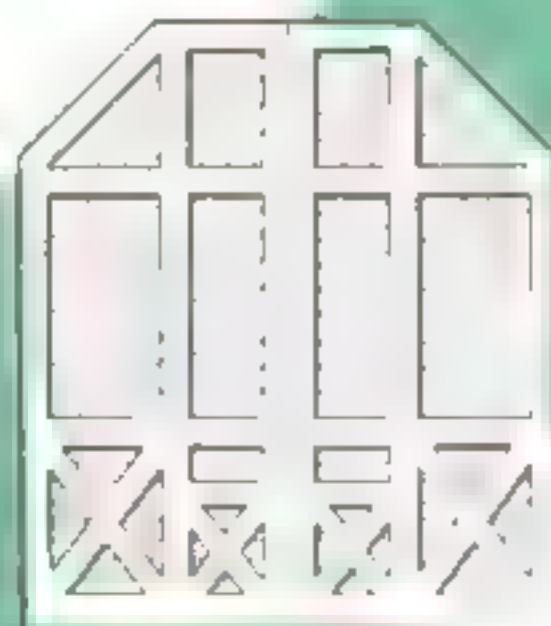
as at B. The ends of the boards were squared and sawed, a second groove was cut as at A, and another strip about 3 in. wide was glued on. The legs were constructed as shown. After sanding, the wood was waxed and polished. If varnish is preferred, reduce it with two parts of pure turpentine for the seal coat, and follow with at least two coats of the full-body varnish.—JOHN H. MOTE.



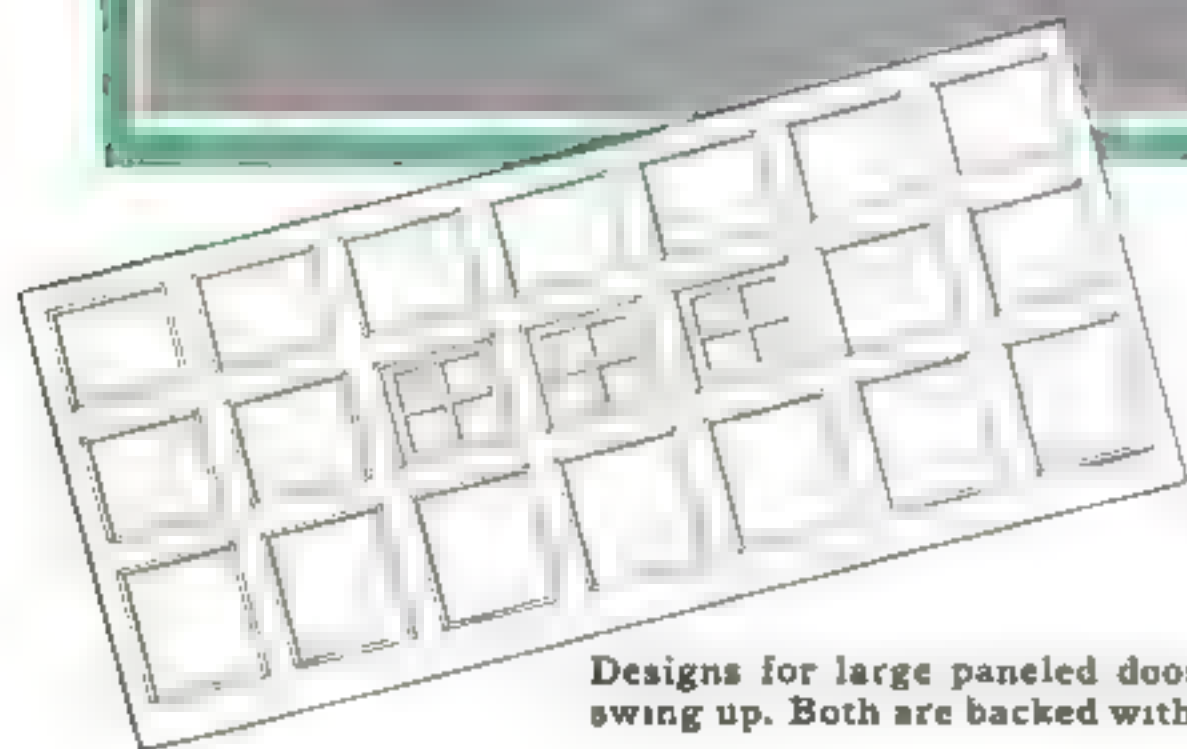
YOU CAN Modernize Your Garage



Single doors hung from an overhead track to allow use of center post



A suggestion for either hinged or sliding doors, braced strongly by the use of diagonal sheathing



Designs for large paneled doors, which swing up. Both are backed with plywood



A
NATIONAL
HOMEWORKSHOP
GUILD
FEATURE

WHAT kind of doors are there on your garage? Are they of the stock frame-and-panel type, made by the thousand at a mill? Are they of the plain board type, faintly reminiscent of a barn and perhaps sagging badly? If so, you will do well to consider replacing them with an up-to-date installation such as those illustrated.

The modern garage door is, indeed, a thing of beauty. And it is an excellent project for the home mechanic, because improved hangers and hinges have simplified construction to such an extent that

any man who is handy with woodworking tools can build creditable doors. Examples are given of overhead-opening, sliding, and hinged doors, together with a variety of designs and constructional details.

The development of bracket hinges of the type illustrated in one of the photographs has popularized the garage door built to swing up overhead. Heavy adjustable springs so counterbalance the weight of the door that it can be opened with a slight tug of the finger, and closing is just as easy. Framing required for this door is of the simplest. The tendency to sag downward when raised overhead is eliminated by iron truss rods and brackets that come with the hinge set.

loosened from its temporary moorings, the hinges are screwed on and the trusses attached.

This is the method: Nail blocks against each side jamb, one near the top, the other near the bottom. Cut two stiles of 2 by 4-in. stock $\frac{3}{4}$ in. shorter than the height of the opening, and wedge them between the floor and top jamb, using the blocks as stops. Drive $\frac{1}{4}$ -in. thick wedges at the top, and $\frac{1}{2}$ in. at the bottom, establishing the clearance. Also wedge the edges $\frac{1}{4}$ in. from the jambs.

Now cut the rails to butt between the ends at top and bottom, and toenail them with four eight-penny box nails in each joint. Put the crowned edge (that bowed up in the center) upward in the top rail, and downward in the bottom, so that wedges can be driven above and below to straighten them and to give the necessary clearance. Next, cut a center rail full width of the door, notching the ends to fit over the inner faces of the stiles, and nail it in edgewise. Finally, fit two diagonal braces running from the lower corners to the center of the middle rail, and the frame is completed for vertical sheathing.

If horizontal siding like that on the building, or any other type of horizontal sheathing is to be used, additional stiles must be nailed in between the rails. For $\frac{3}{4}$ -in. sheathing, three of these, evenly spaced, are enough, but more should be used if thinner surfacing is to be used.

When windows are put in, trim the openings as shown. For fixed sashes, make the inside of the framed opening to fit, but for hinged windows it is necessary to build frames, with corresponding clearance space left in the opening.

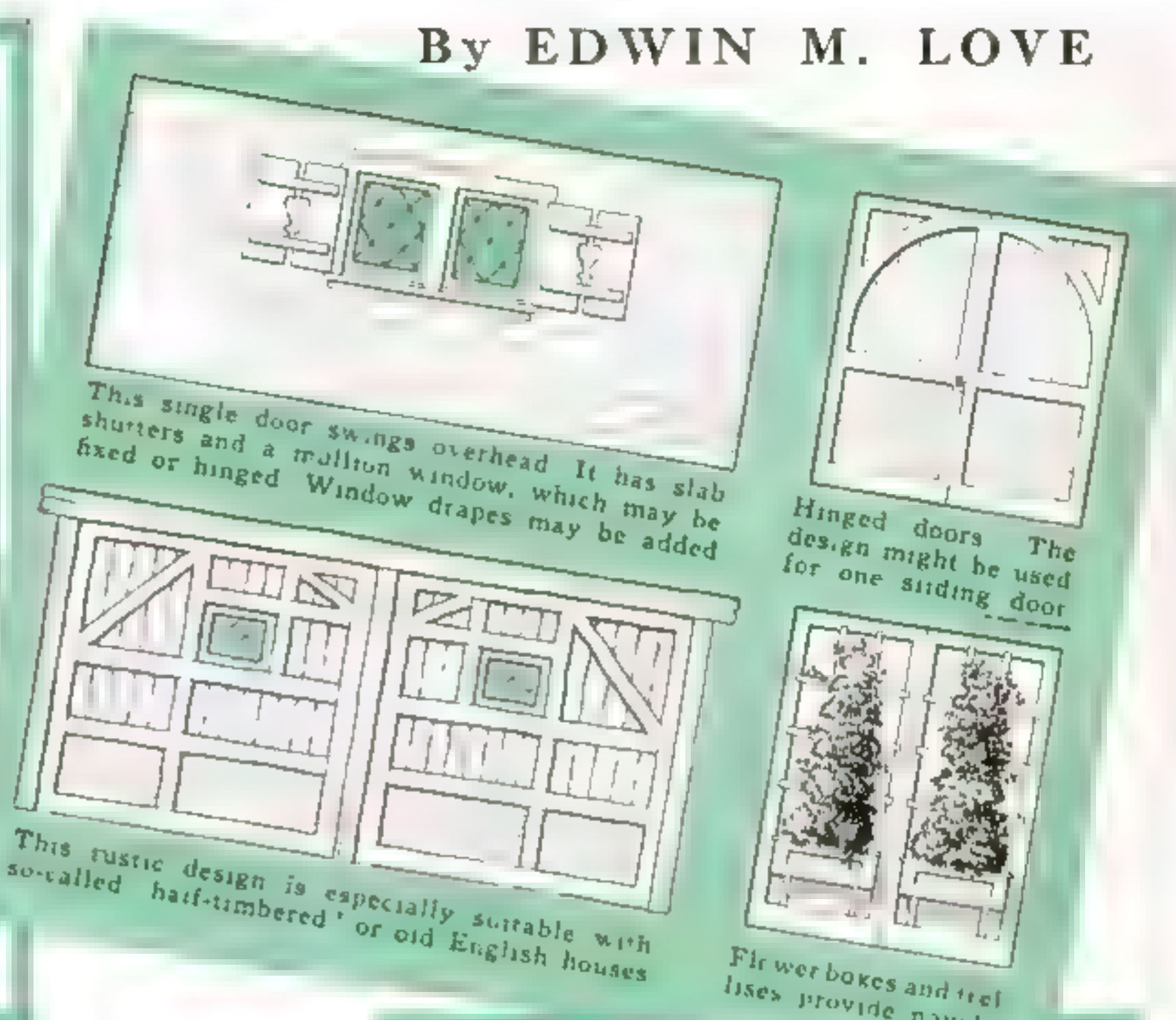
Before putting on the sheathing boards, cut the long ones to length. After squaring one end of all, nail a block to the cut end of one, cut it to length, and use it as a length pattern by hooking the block over the cut ends of the others while marking the other ends. Since it is generally best to center vertical sheathing on the width, clamp two or three boards to-

by Building New Doors

By EDWIN M. LOVE



Hinged pair with paneling, curved top, and wrought-iron hardware



gether to measure the width, and check accordingly from the center of the door. Boards ripped to finish out the edges will then be about the same width. Before nailing up, coat the tongues and grooves with thick paint or white lead, or if they are to be stained, apply dark paint where it will be hidden, or weatherproof varnish, for bare wood in a joint invites moisture and early decay.

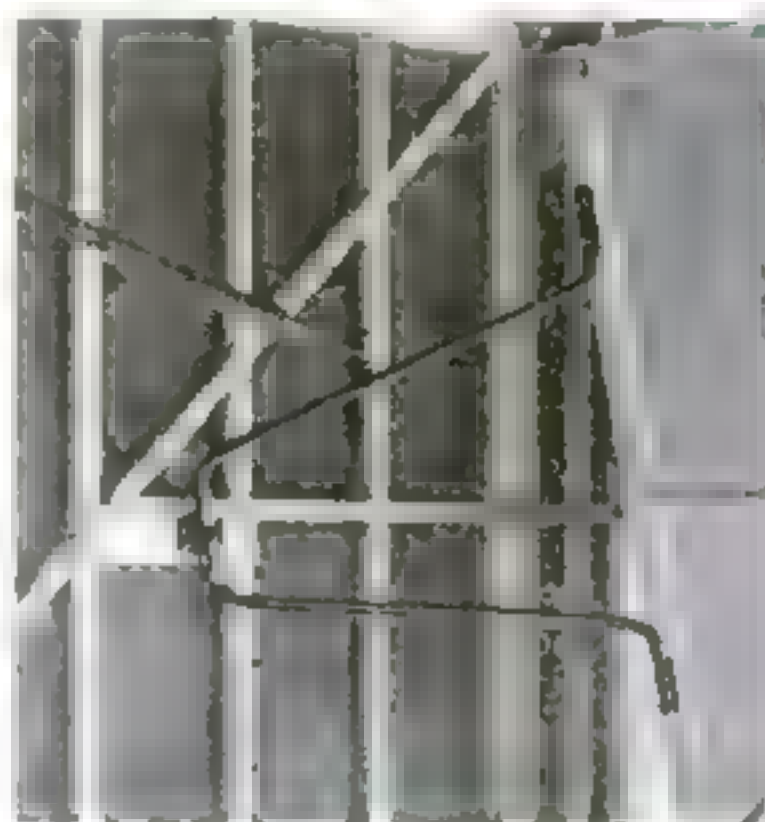
If fixed windows are to be installed cut the boards flush with the trimmers and use a panel molding to stop the sash against, or let the sheathing project from 1/4 to 1/2 in. inside the opening to form the stop.

Attach the truss rods and hinge brackets, drive off the blocks and wedges, and the door is built.

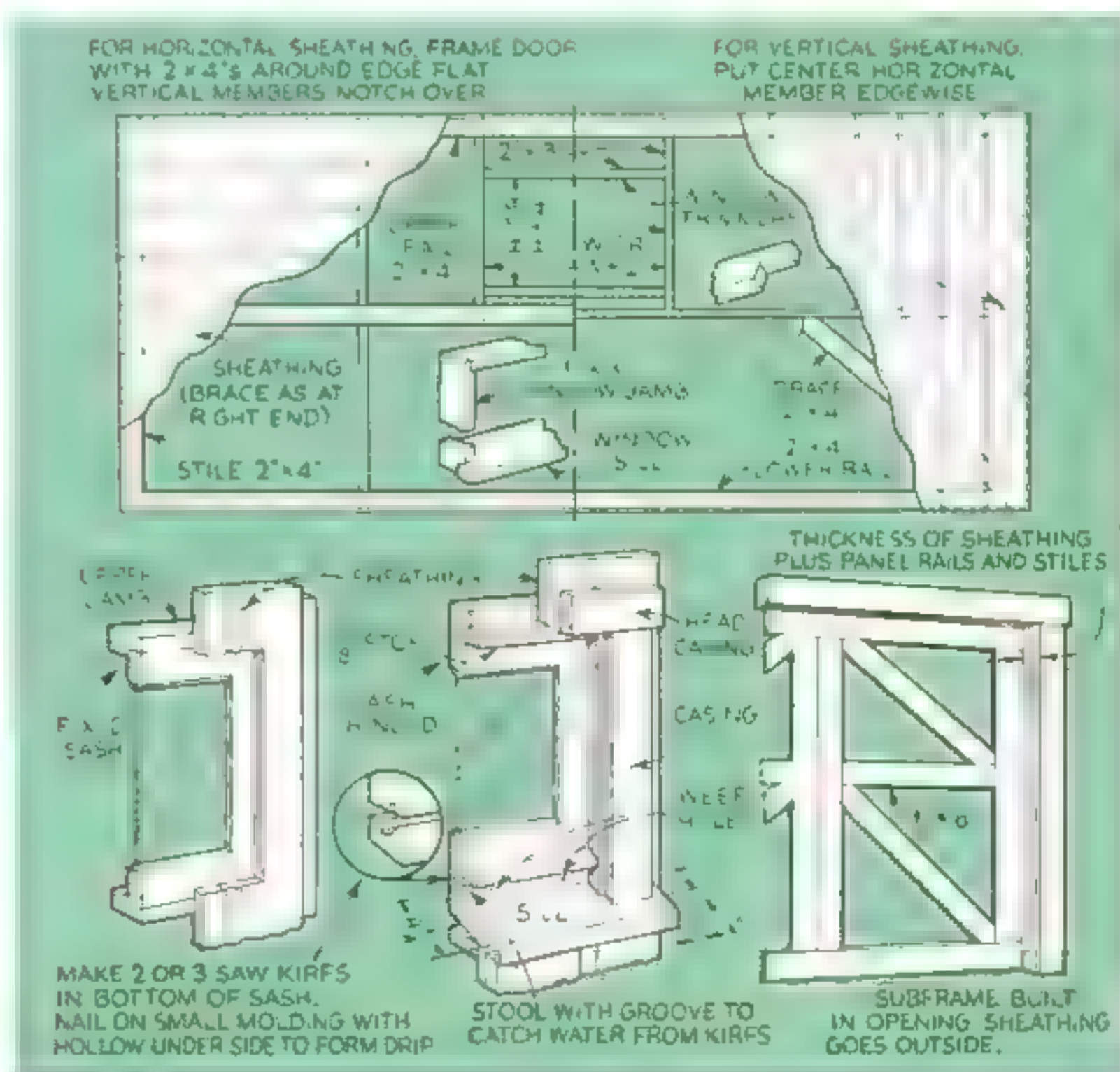
Sliding doors can also be built in place. However, if two are used, one must slide past the other, and thinner doors are desirable. A braced frame with butted joints, of 1 by 6-in. stock, is built and surfaced with the sheathing, and an overlay of stiles and rails is nailed in front. Sheathing nails can be clinched behind by a second person, who holds a hand ax against the back, or the projecting ends can be bent over with a hammer and doubled in with a nail set. If there is a center post dividing the opening, make the stiles next it wide enough to lap behind, so that the visible width, when the doors are closed, will be equal to the jamb stiles. If there is no post, put in a temporary one, and make the inner stiles of the doors lap, one in front of the other. Fixed sashes can be installed, but hinged windows are not very practical unless the casings are made to project inside the jambs, serving as stops, the frame being flush on the backs.

About the same procedure should be followed for a pair of hinged doors, except that two stiles are put at the center. After hinging, saw the doors apart between the stiles and nail a thin strip along the back of one door to project 1/2 in. over the other, forming a rabbet.

Two of the paneled doors illustrated here have plywood backing. Since most plywood is not very weather-resistant, care should be taken to paint it well and to putty all cracks. So treated, the doors are surprisingly durable.



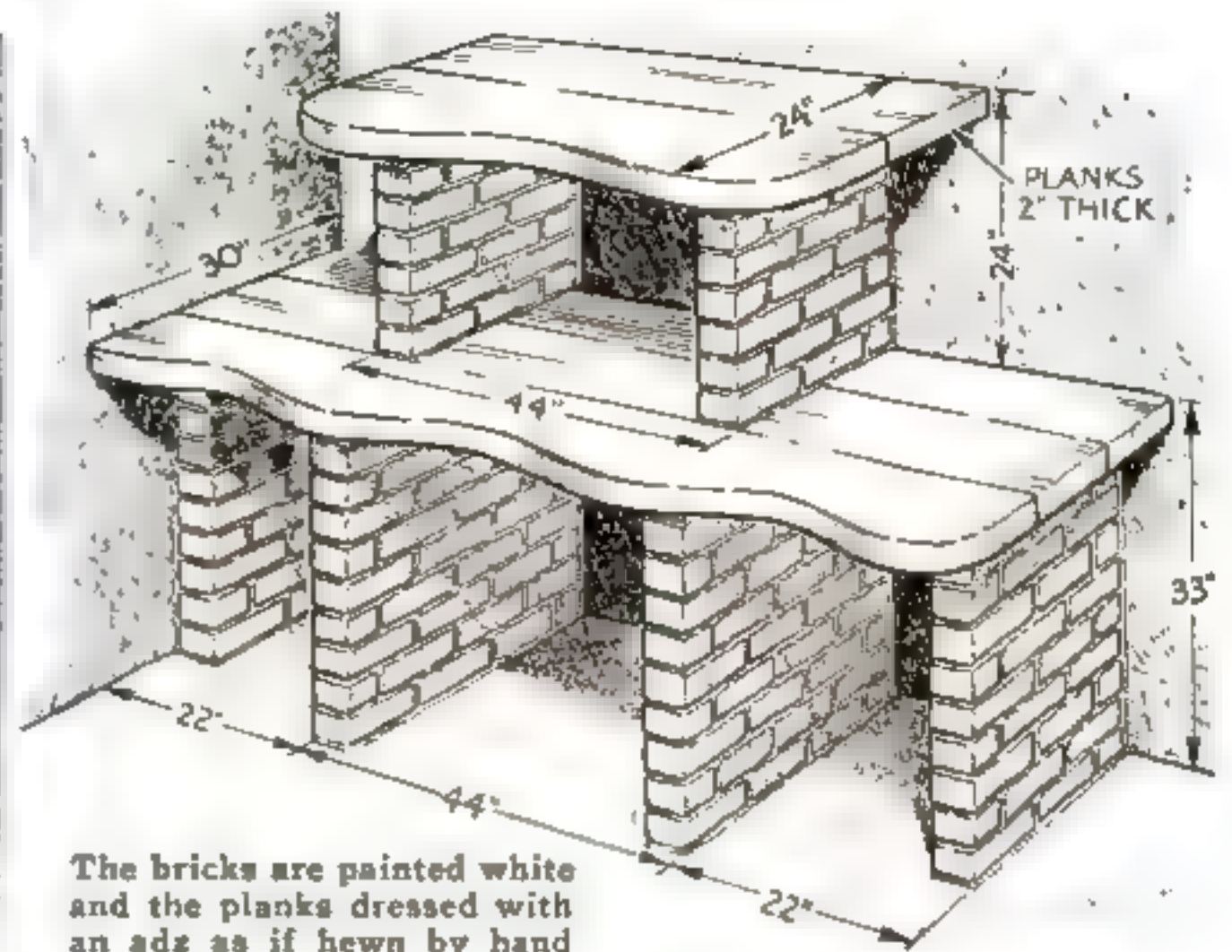
A single door. Left: Bracket hinge with spring. Note truss rod on upper rail. Below: Construction methods



BASEMENT BUFFET MADE FROM BRICKS AND PLANKS



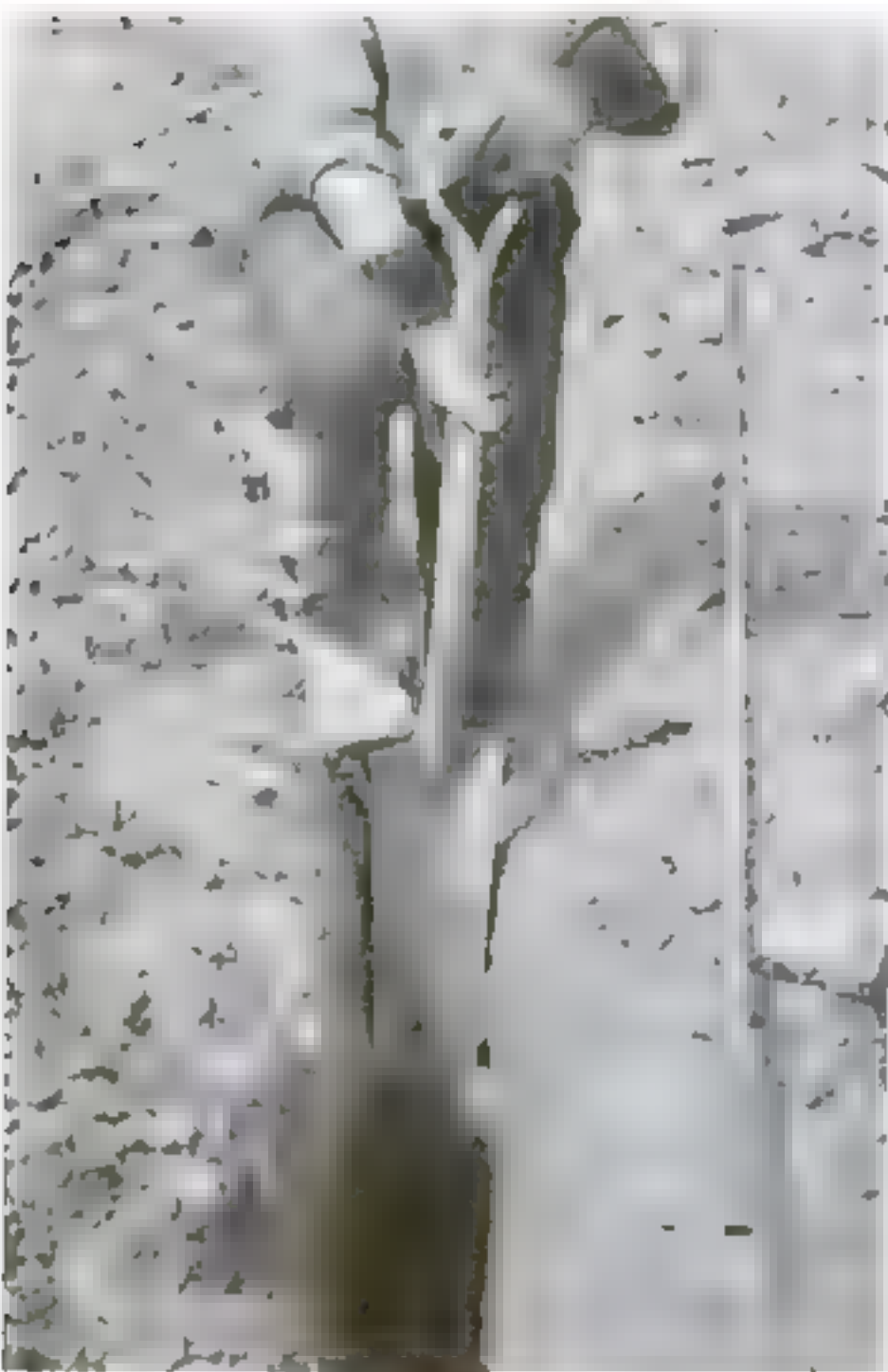
The buffet is used for preparing informal suppers in a basement recreation room



The bricks are painted white and the planks dressed with an adz as if hewn by hand

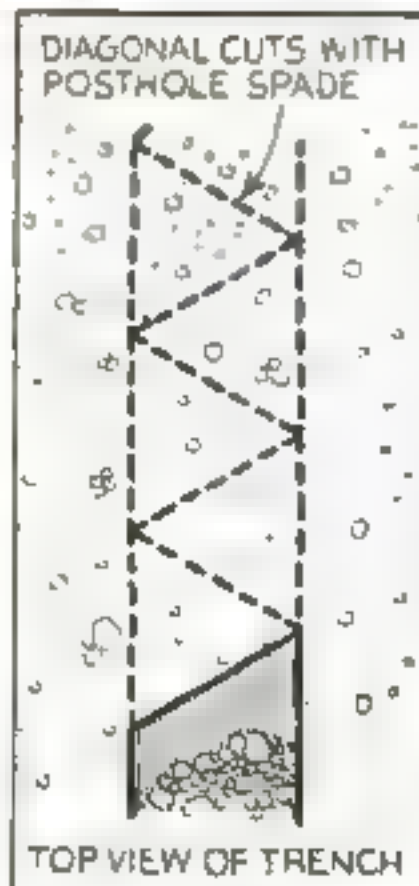
FOR serving informal suppers in a basement recreation room, a convenient buffet can be constructed of no more expensive materials than rough planks and brick. The one illustrated is in the basement of a house in Altadena, Calif. The brickwork is simply painted white; the planks are adzed to give a hand-hewn finish, but not painted, stained, or varnished.—H. S.

FORMING CORRUGATIONS IN THIN METAL

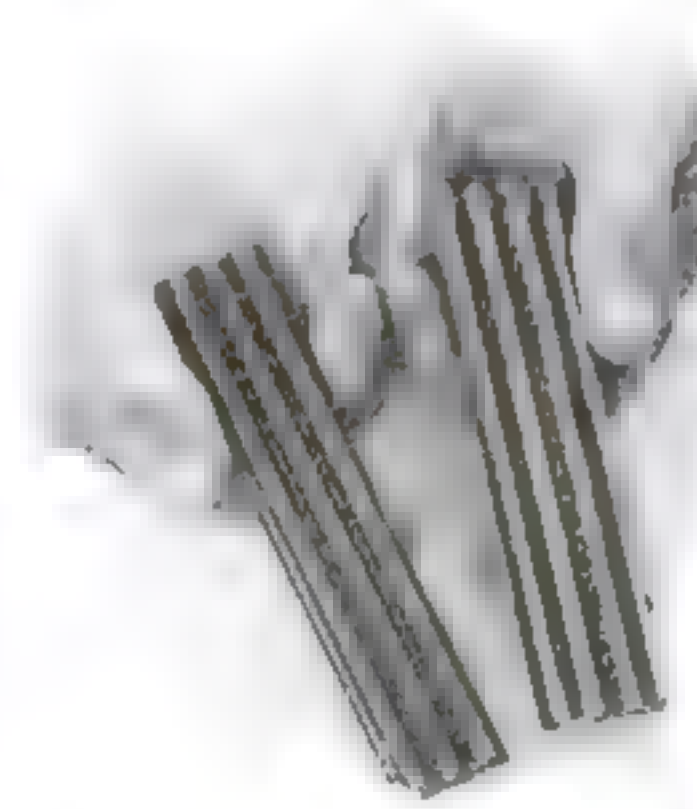


PIPE TRENCH DUG WITH POST SPADE

IN LAYING pipe, the trench need be little wider, of course, than the pipe itself, and all extra dirt removed is merely to make room for the shovel. By using a posthole spade, which is about 8 in. wide and 16 in. long, and taking diagonal cuts as shown in the diagram, relatively little soil need be removed.



The spade is used at an angle to dig a trench as narrow as that illustrated in the photograph above



The lead dies, cast in a mold made from a corrugated packing board, are used as at the right



WHEN it is necessary to form corrugations in strips or sheets of thin metal to serve as guides, holders, adjusting pieces, and the like, the work can be done with lead dies. Cut a piece of ordinary corrugated packing board to the desired size, protect it with a coat of water glass, place

it in a suitable cardboard box, and use it as a mold for casting the lead. The dies are used in a vise as illustrated. Three or four corrugations may be made in lightweight metal at one turn, but for heavier metal, feed the strip through by doing one corrugation at a time.—K. N. H.

OLD TIRE TURNED INSIDE OUT TO SERVE AS FLOWERPOT

PAINTED to resemble Navaho pottery, this garden ornament is made from a discarded automobile tire of the so-called "full balloon" type. The tire is first turned inside out, an operation requiring some strength and much patience. One person holds one side of the tire firmly on the ground while some one else on the opposite side uses two large monkey wrenches to do the actual turning. This is continued around the entire circumference.

For use as a flowerpot, the bottom is made from the head of a barrel, or boards are cut to fit. A hole is bored for drainage.—BOB McLEAN.



Flowerpot painted to resemble Navaho pottery

Decorative Wire Working

With a drawplate, either purchased or homemade, you can develop a variety of ornamental shapes

By
KENNETH MURRAY



When drawn to the correct size and shape, the wire may be twisted by hand or, more conveniently, in a lathe with a hollow headstock



This cigarette humidor and ash tray is an example of the countless craftwork projects that may be decorated with various forms of twisted wire

ONE of the most useful workshop tools is the drawplate, with which the diameter of various kinds of wire can be reduced and the length correspondingly increased.

With certain types of drawplates the shape of wire also may be changed. Square, half-round, oblong, triangular, and other wire shapes have unlimited possibilities for decorative purposes. Alone, twisted, or in combination, they can be used for ornamenting metal and wood projects as well as for making chains, jewelry, and articles of that nature.

Commercial drawplates, which are made of very heavy steel and are accurately cut and tempered, are recommended, but when cost is a consideration it is practicable to make one. The principal tools required are a fine drill and one needle or escapement file of the desired shape for each different style of hole.

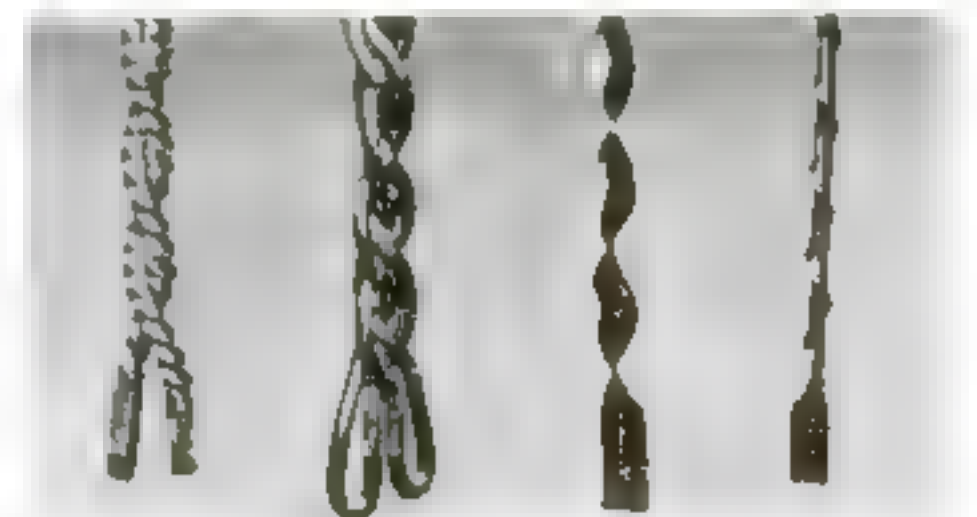
About the best steel commonly available is a discarded circular saw blade, the thicker the better. Remove the temper by bringing it to a red heat over a gas flame and allowing it to cool slowly. With a metal-cutting saw, remove an oblong section. A piece 2½ by 6 in. is large enough for three sets of holes.

After scribing two or three lines across the plate, make equally spaced prick-punch marks along each for the primary holes. Use a drill that is slightly smaller than the smallest hole is to be when the plate is completed. With a larger drill, countersink the holes for about half the thickness of the plate, no more.

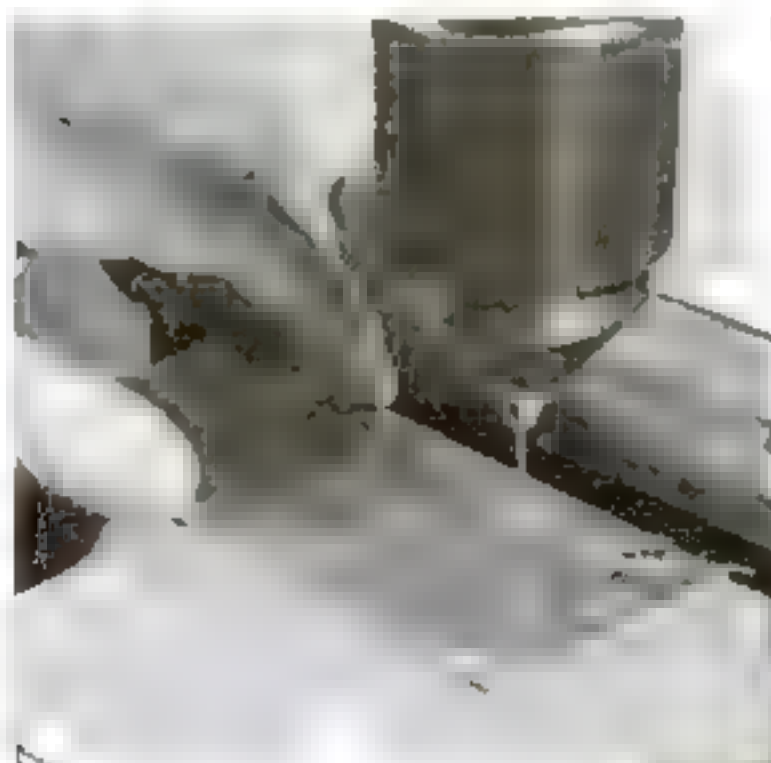
Slender, needle-pointed (Continued on page 104)



Left to right: Round wires twisted . . . flattened . . . twisted with another round wire . . . two large twisted, and two small wrapped around



Square wires twisted separately, then together . . . two sets round, twisted separately, then together . . . flat, with loose twist . . . same, tight



The first step in making a drawplate is to drill and countersink the primary holes. Then support the plate as at the right, with a light below, and shape the holes with files



In the tempering process, reheat the hardened drawplate over a gas flame until it takes on a straw-yellow color. It is then plunged in water



A completed homemade drawplate with three series of graduated holes for round, triangular, and square wire

Square wire twisted at intervals . . . twisted in alternating directions . . . square wire given a slight twist . . . square wire with a very tight twist

HINTS ON Painting Exterior Trim

By RALPH G. WARING



Above: When painting sash, do the lock rail first. Right: Painting the outside casings. The top or head casing is done first, then the side casings. The sill is left to the very last



A NEIGHBOR dropped into the laboratory the other day and asked if I could spare a few minutes to look at his house. "It's about the paint," he explained. "I paid a man seventy-five dollars to paint the house two years ago, and furnished the paint myself. I thought it was a good deal, but you should see how it has turned out!"

We went down the street a few doors to a well-built frame house with western red cedar siding. I checked the entire job—water table, siding, window casings, cornice, and trim—and also noted in the garage several nearly empty gallon cans and a pail in which several good brushes, solid with paint, were standing in water up to their handles.

"Well, neighbor," I said, "it looks as if you wanted a cheap job, and unfortunately that's just what you got."

I pointed out that the man must have

been just a brush hand, not a real painter, or he would never have left good brushes full of paint to harden and dry all out of shape. Brushes should always be well cleaned and placed in a mixture of pure turps and raw linseed oil so that the bristles are suspended at least an inch above the bottom of the can. The liquid should cover the ferrule to prevent drying in the heel of the brush.

I lifted from the siding some of the loose flakes of paint and showed the dirt specks on the back.

"With auto traffic such as we have

today," I said, "siding and other exterior woodwork really should be washed with a modern cleanser before being repainted. You saved the twenty-five dollars an experienced washer would have charged you, but look at the loss and annoyance that has been caused by the failure of the paint coat."

"Then you bought a line of low-priced paint not suitable for this work. You will see on the label a statement that the paint is reinforced with a certain very modern type of varnish. It's a fine varnish, but there is no place for it in any outside paint formula."

My advice was that he get the permission of his insurance company in writing and then have a reputable firm of contracting (*Continued on page 117*)



Although it is rarely done by amateur painters, the best practice is to trim the inside face of sash simultaneously with the outside. Always stroke away from corners towards the center



Good paint gone wrong. This is what is likely to happen when a paint containing varnish, even if of high grade, is used outside



After the sash has been painted, the jambs and thumb moldings must be coated. A 3-in. XXX brush is convenient for all such work

LATHE WRENCHES KEPT READY FOR USE



The chuck wrench may be lifted instantly from its wire holder when needed for adjusting the chuck jaws



The holder is merely a piece of wire with a small loop in to which the wrench is set

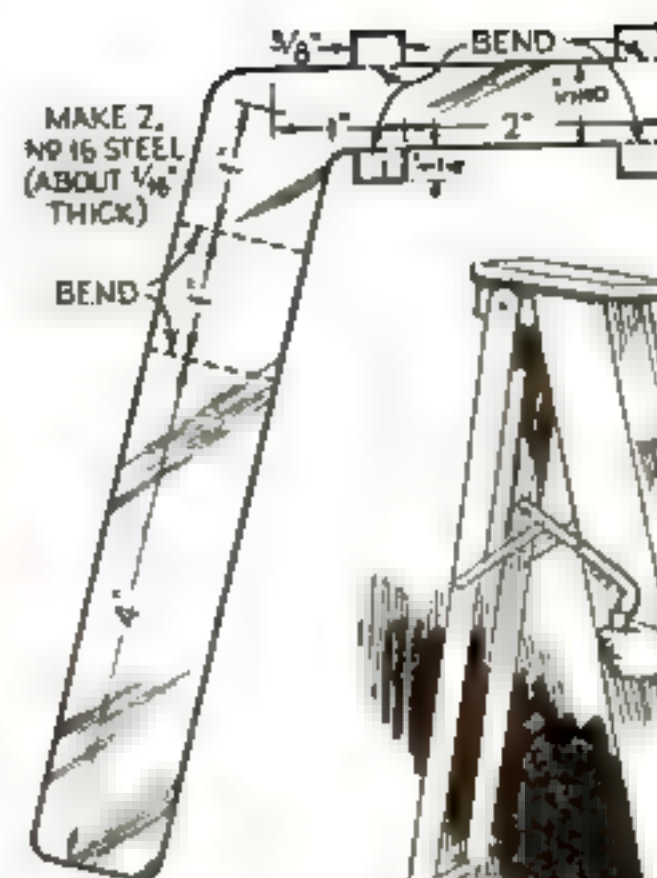


Wrenches for the gear train are hung inside the gear cover

CERTAIN wrenches are used constantly in the course of any work done on a metal-turning lathe. The chuck wrench, for example, should be instantly available, yet only too often a hunt is required to locate it. After trying various places, I found the most convenient to be on a wire rack within 5 in. of the chuck itself, as shown in two photographs above. Kept here, the wrench does not find its way into the cuttings that accumulate under the bed of the lathe.

Similarly, it was often necessary to search for the wrenches needed to adjust the gear train on a screw-cutting lathe until two pegs were placed inside the

gear-cover casting. Hung on these pegs, the wrenches are conveniently placed. Two holes drilled in the position shown and fitted with taper pins solve the problem. Other arrangements can be devised to suit conditions.—W. WALDEMAR.



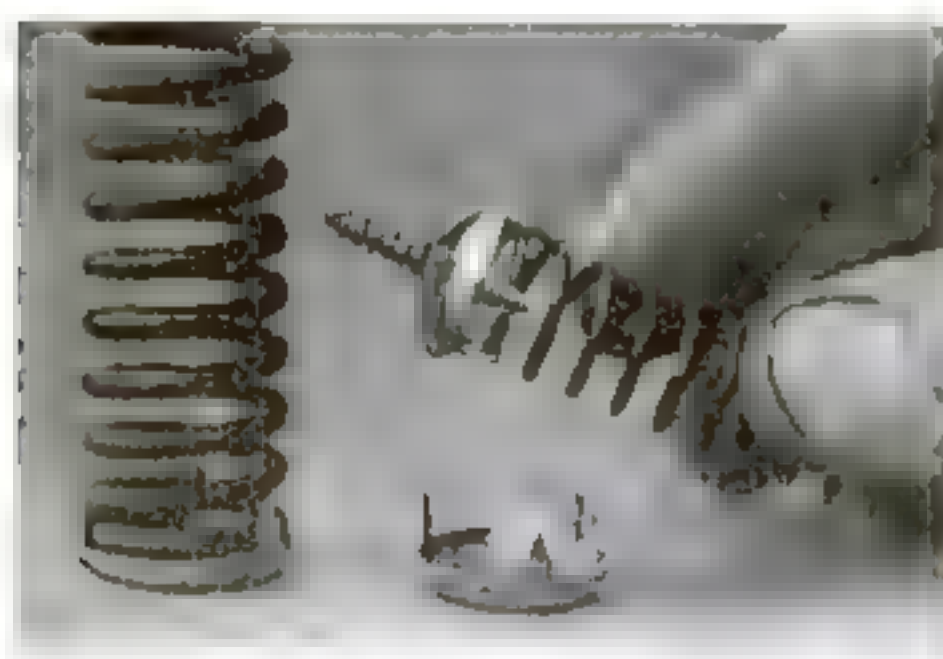
Above: Pattern for cutting the metal handles. At right: How they are used



HANDLES ON STEPLADDER PROTECT YOUR FINGERS

MANY fingers have been pinched in opening and closing a hinged stepladder. This may be avoided by making two handles as shown and fastening them to the ladder braces either by bending four small tabs around the brace or, if preferred, by riveting. Use steel at least 1/16 in. thick. Make a cardboard template, trace around it, and cut the steel with a hack saw. Smooth the handles with a file and heat them before bending one right-hand and the other left-hand.

With these handles in place, the ladder is opened by holding it in front of you and pulling them toward you. This forces the rear part of the ladder back. Reverse the operation to close it.—L. N. OLSEN.



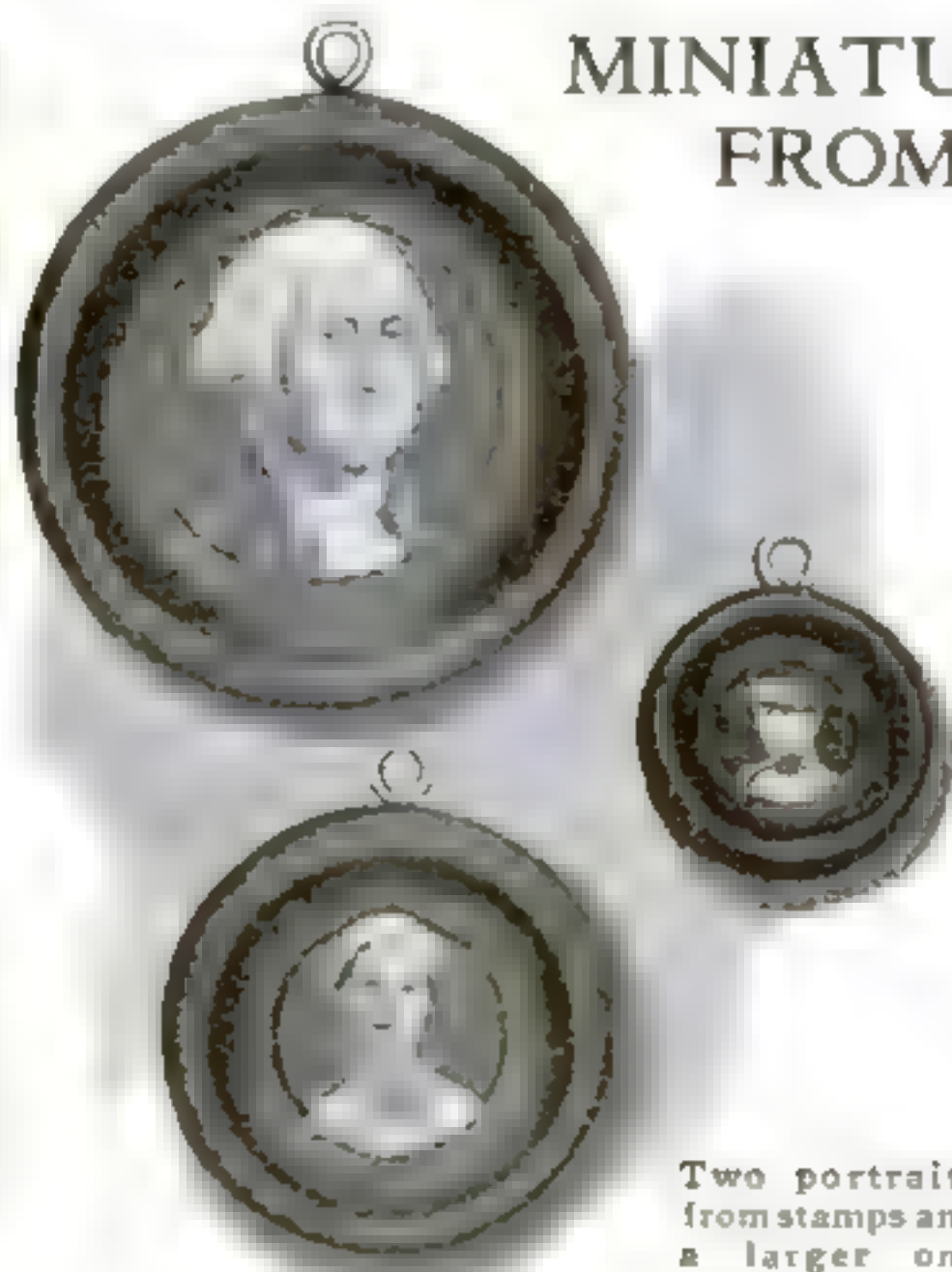
FURNITURE GLIDES USED AS SPRING SEATS

WHEN it is necessary to devise a way to hold the end of light compression springs on wood or metal, ordinary furniture glides may be used as shown above. A hole for the screw is drilled through the center of the glide, and the three stiff prongs keep the spring in place.—F. B.

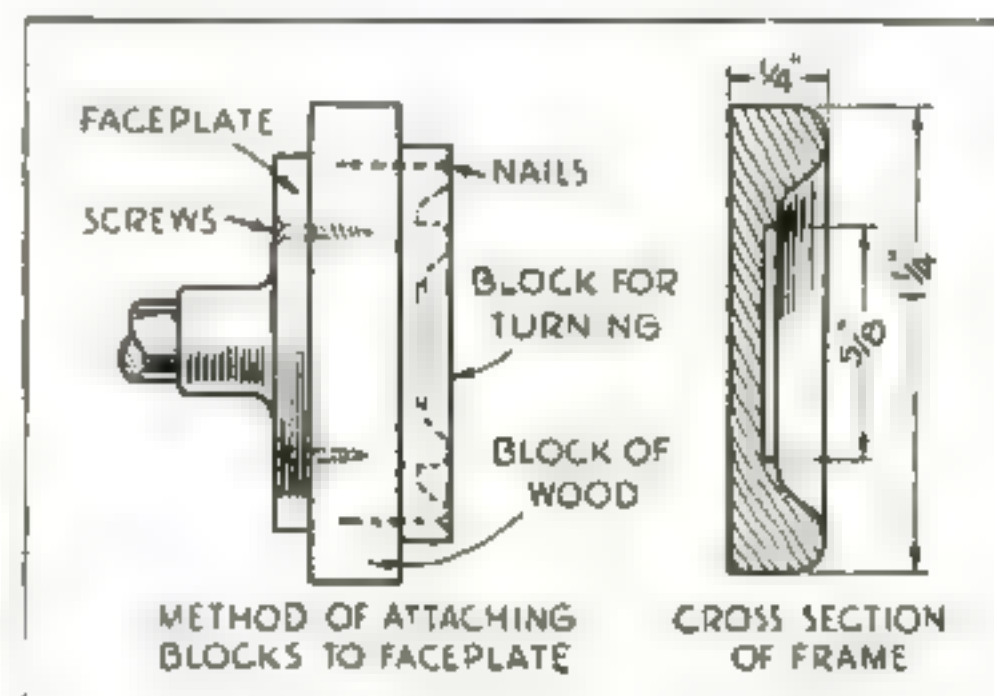
FILING CROSSCUT SAWS

TO SHARPEN a crosscut saw of the type used for logs and cordwood, it is important that the blade be held firmly. An easy way to do this is to set two posts in the ground about 3 ft. apart and the desired height, and make a saw cut about 4 in. deep in the top of both posts at once, using the same saw. Then place the saw, teeth up, in the slots. For very long saws, a third post may be added.—W. M. CARLE.

MINIATURE PORTRAITS MADE FROM POSTAGE STAMPS



Two portraits from stamps and a larger one from a circular



them where they will be out of the way of the turning tools. If the stock is fastened with nails, be sure to sand out all chisel marks before cutting through the block around the outside of the frame. It is well to turn the lathe by hand and use a penknife to finish the cut.

Fill the wood with a paste filler that has been stained to the color desired, and apply boiled linseed oil with a soft, clean cloth after the filler has had time to dry.

For the pictures, cut faces from uncanceled stamps, paste them in the frames, and protect with thin, clear lacquer or varnish. Suitable portraits can also be obtained from other sources. The head of Washington, for example, is from a lodge announcement.—GEORGE A. SMITH:

Circus Wagons IN MINIATURE

By George L. Cole

THE circus is coming! These are the magic words that herald the approach of one of the most colorful and romantic spectacles of American life. We can keep alive their stirring significance in no better way than by building miniature circus wagons of the type illustrated.

From maple or other hardwood, turn half molds on the lathe to use in casting the lead wheels. Drill the 3/32-in. axle hole and groove the outside half of each mold with a wood-carver's veining chisel

to represent sixteen spokes. Place the halves together, insert a tenpenny finishing nail, apply a clamp, and drill a 1/8-in. pouring hole into one side to the depth of the wheel rim. Countersink this hole deeply. After the shavings have been emptied from the mold, it may be clamped again and the first wheel cast. Then pull the molds apart, drive the nail out of the wheel, file off any irregularities, and drill 3/32-in. holes between the spokes next to the rim as shown.

For the remainder of the work, the drawings are self-explanatory. The floor, top, and ends may be cigar-box wood or any 3/32-in. softwood. Nail top and floor temporarily together, spot the locations of the bar holes by stepping them off with a compass, and drill with a No. 28 drill. Make L-shaped corners from 1/2-in. square softwood by ripping out a piece 3/8 by 3/8 in., or carve or turn these parts in any way desired. Assemble the top, floor, ends, and corner pieces with glue and 1/2-in. pins, known as "lills." Paint the interior white.

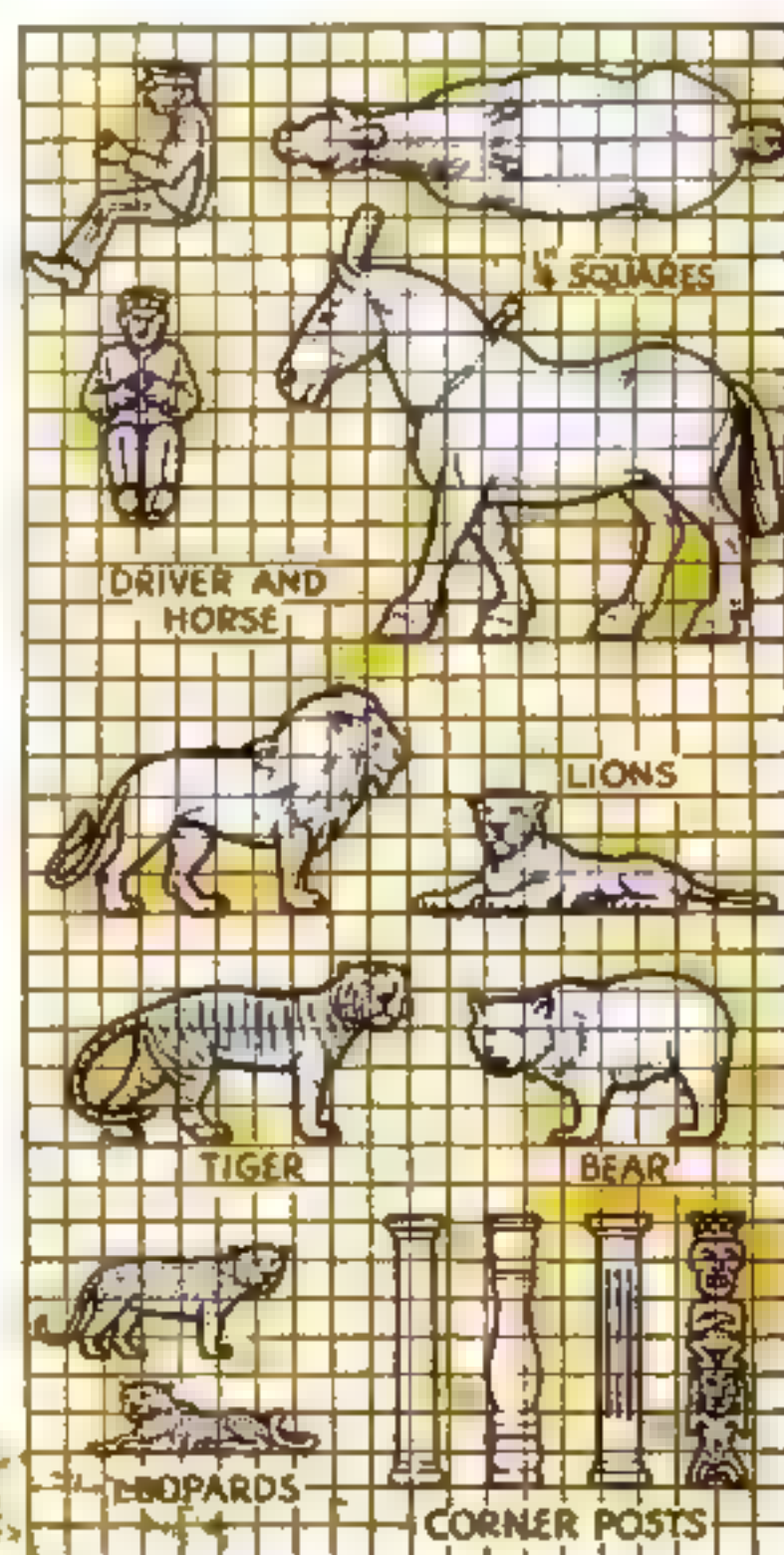
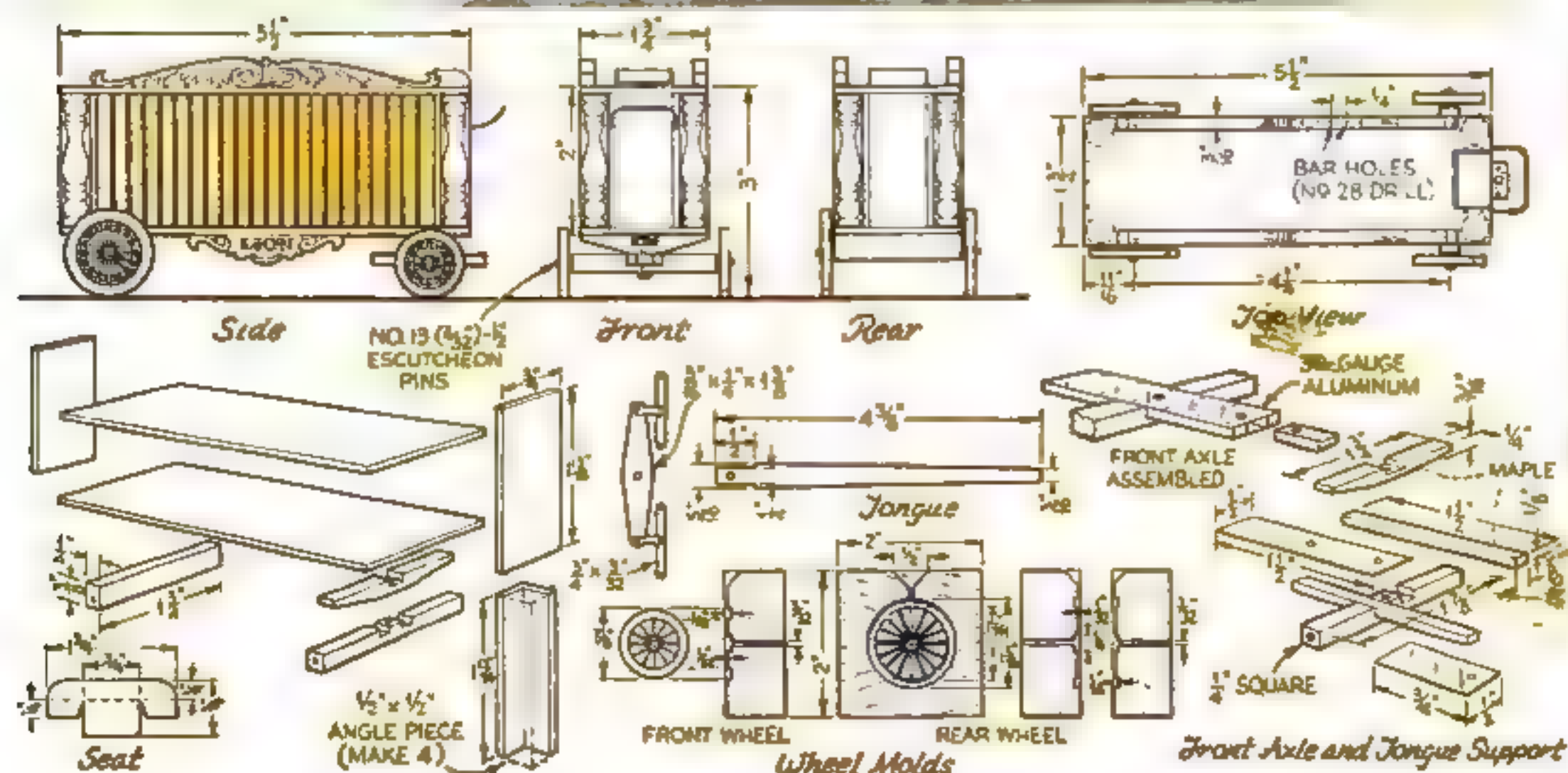
The wagon construction is of the simplest type, with wire bars inserted through holes in the top and bottom pieces. The difficulty of making wheels is overcome by casting them from lead in two-piece hardwood molds



A model of a circus wagon not only makes a fascinating toy, but also serves as a picturesque, colorful mantel ornament

Make the rear axle and the front-axle assembly and tongue support and attach the latter to the body with a 1/2 by 1/8-in. bolt. Cut the seat from heavy Manila paper and bend the footrest from 30-gauge stove wire, inserting the ends into holes. Cut the bars from the same size wire, straighten them with pliers, and insert.

Decorations may be merely painted on or carved and painted. Brilliant colors are always used, such as gold on red, green, or white. Animals may be purchased or jigsawed and carved from softwood, preferably yellow poplar. Horses and drivers are made in the same way.



The assembly drawings, details, and wheel molds are given at the left, and drivers, horses, animals, and wagon corner posts are shown above on squares to make enlargement easy

SOLID SCALE

Plane Model

HAS SHAPELY WINGS

By
DONALD W.
CLARK



OUR scale model airplane plans this month are for the Waco "D" Commercial. It is a plane that may also be used for sport and, if necessary, it can easily be converted for military uses. Biplanes of this type are widely known throughout the world for their remarkable performance and dependability.

The specifications are: Span, 32 ft. 9 in.; length 25 ft. 6 in.; height, 8 ft. 11 in.; weight empty, 2,500 lb.; engine, Wright R975E, 330 h.p. at 2,000 r.p.m.; high speed, 175 m.p.h.; cruising speed, 153 m.p.h.; landing speed, 56 m.p.h.; service ceiling, 16,000 ft.; rate of climb, 1,350 ft. per minute.

The model is built on our usual scale of $\frac{3}{8}$ in. equals 1 ft. of the full-size plane and requires twenty-four parts. The shapely wings, it will be noted, are staggered and have both sweep-back and dihedral, which combine to make the construction a little difficult. The wing roots will turn out all right, however, if the blanks are marked properly before they are carved. Shape the inner sides last and try them by sliding them on the wing pins. Continue cutting them until they fit snugly

Wings for this Waco "D" Commercial model are staggered and have both sweep-back and dihedral. Mark all blanks carefully before carving

against the fuselage, then fasten them with glue.

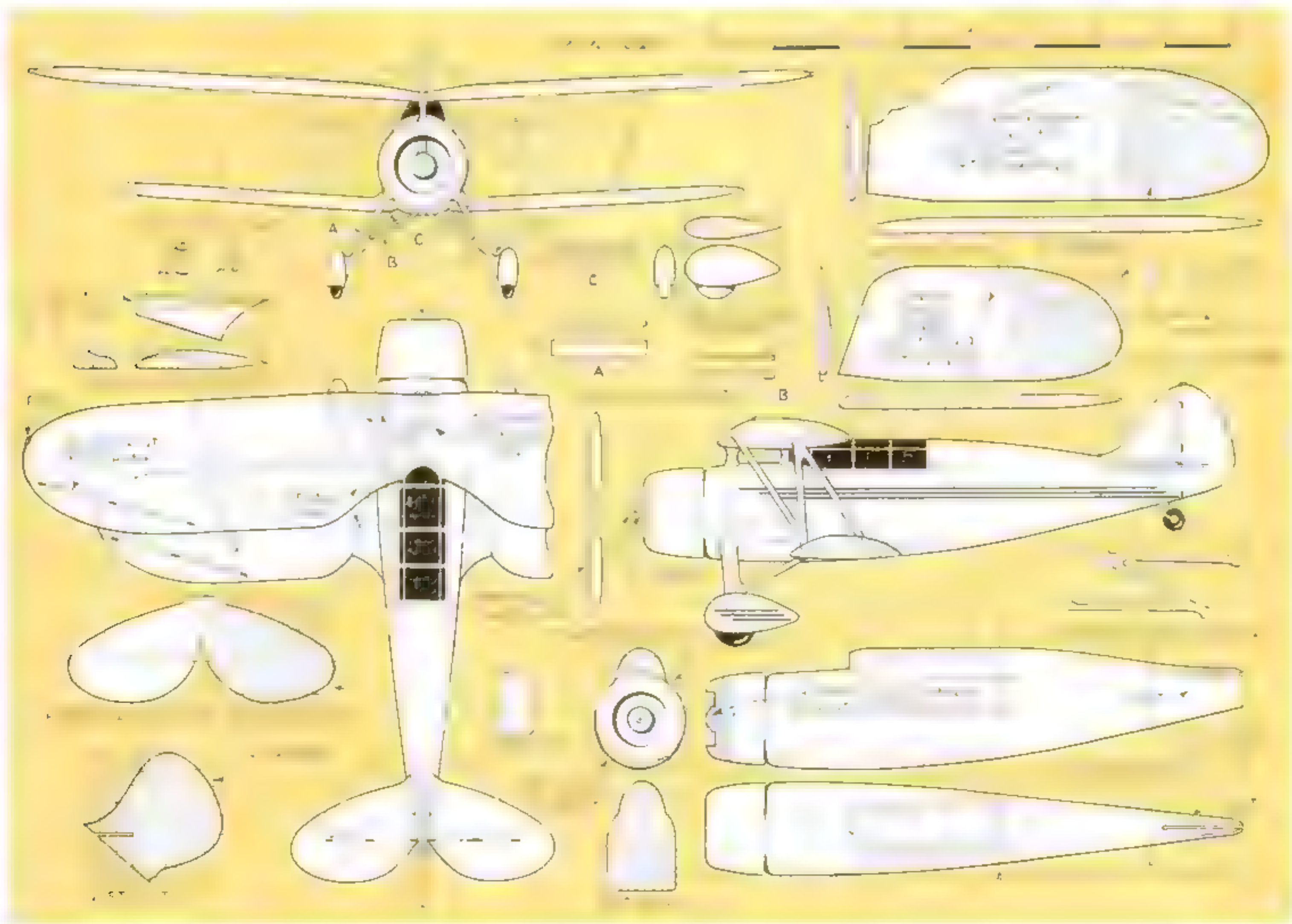
A color scheme to bring out the graceful lines of this well-designed plane is as follows: Apple green for fuselage, vertical tail, "pants," and all struts; yellow for wings, horizontal tail, and trim; black for windows, cowl recess, tires, and details. Black may be used instead of yellow for the trim, if preferred.

Putting the trim on the body calls for considerable patience. To make the job easier, draw the lines with a hard pencil on the wood before painting, then follow the lines with a small brush.

If the model is mounted on the end of a stiff wire set into a block base, it will make a colorful ornament for living room, den, or boy's room. A painted background will add to its realistic appearance.



Above: The twenty-four parts that are necessary for constructing a scale model of the plane. At right: How a ruler is used to measure accurately one of the ailerons



Assembly views and details showing how blanks should be marked. The size of the model in relation to the original plane is $\frac{3}{8}$ in. equals 1 ft

Capt. E. ARMITAGE McCANN

tells how to

Plank *the* Hull



At the left Captain McCann is "nailing" the deck-beam support or clamp inside the frames. Above is the frame with the fillers between the deck beams in place



The garboard (bottom) strake is in place, and now the second broad plank is being nailed on

AMONG wooden shipbuilders, William H. Webb is considered by many authorities as the greatest of all time. His yards stretched from Fifth to Seventh Streets on the East River, New York, and his enduring monument is the Webb Institute of Naval Architecture. The first vessel he built for his own account was the *Malek Adhel*, which he described as a "handsome and fast sailer." And now we are constructing a model of the *Malek Adhel*, following Webb's own plans and using regular frame-and-plank construction.

In last month's article (P.S.M., Mar. '37, p. 77) we got as far as erecting the frames on the keel, with stem, stern, and keelson. Reference should be made to the plans published in that issue while the construction is continued.

From the sheer plan, recheck the height of the battens for the deck line and mark that height on each frame. Now remove

the template frames and replace them with the permanent frames. Cut a keelson $\frac{1}{4}$ in. square to lie on the frames from the forward to the after deadwoods. Nail it down through the frames into the keel.

The deck beams come next. They are $\frac{1}{4}$ -in. square and lie on a batten called the deck-beam clamp. This clamp is about $\frac{1}{8}$ by $\frac{1}{4}$ in. and extends from end to end of the hull, being nailed inside the frames $\frac{1}{4}$ in. below the deck line. It may need steaming at the forward end to bring it into line. Cut the top edge horizontal at ends.

On the inside, about halfway between the deck-beam clamp and the keelson, nail another simi-

lar batten or stringer to all frames.

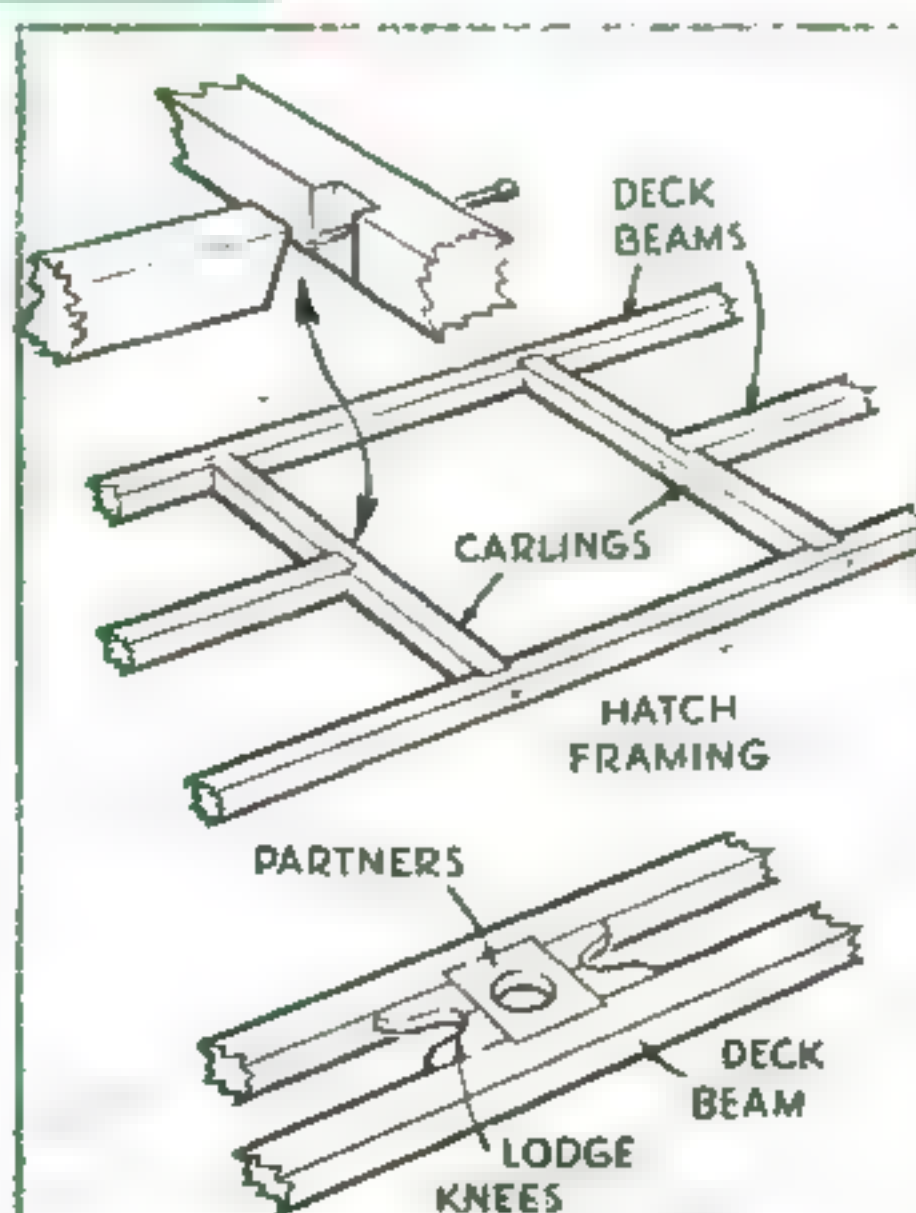
The deck beams have a camber or curve from the middle to the sides amounting to $\frac{1}{4}$ -in. rise in 1 ft. To insure their being alike, I cut them to the length of the longest ($47\frac{1}{8}$ in.) and shaved down the camber of all, above and below, and also marked a midship line. I then fitted each individually, keeping the midship marks in line. Be sure that the beams are just $\frac{1}{4}$ in. deep at the ends; if not, pad them up or shave down until all are level. I put in a beam at every other frame with extra ones to support the masts.

Between beams H-F and 12-14, mast partners are required to hold the masts in position. These pieces, combined with their supporting lodge knees, are $\frac{1}{8}$ in. thick and are let into the beams. Fix these beams and partners temporarily in position to get the right position for the mast steps. The rake or angle can be determined by using temporary masts and sighting them with a piece of cardboard cut to the correct slant. The foremast rakes 2 in. to the foot, and the mainmast $2\frac{1}{4}$ in.

The steps are pieces of $\frac{1}{4}$ -in. wood, long enough to take in two frames, with $\frac{1}{4}$ -in. square holes for the mast heels. They are beveled underneath to enable them to rest on the keelson.

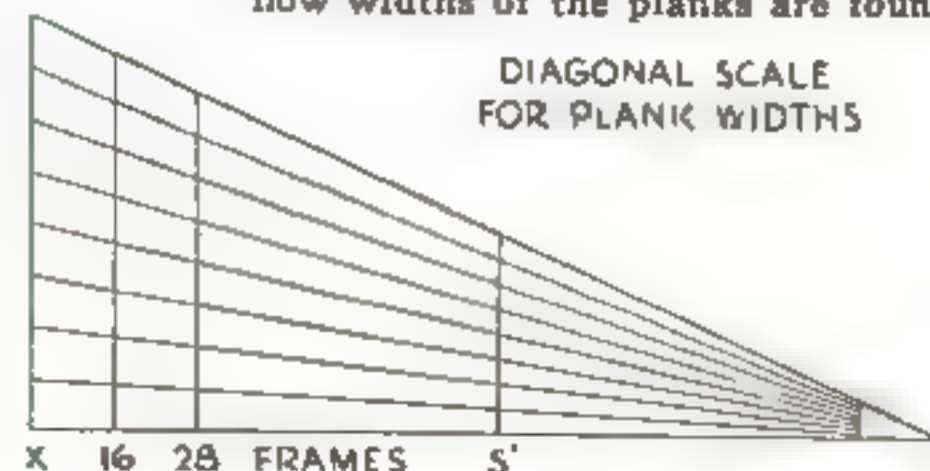
Some beams, it should be noted, have to be cut and carlings (fore-and-aft pieces) inserted for the hatch openings. The hatch and skylight coamings (described later) will be $\frac{1}{8}$ in. thick and rest on the beams and carlings, so if the openings in the latter are the same as the inside of the coamings, that will leave $\frac{1}{8}$ in. to nail the deck to.

At intervals there should be $\frac{1}{4}$ -in. square stanchions, joining beam to keelson. They are made a neat fit and held



How carlings are used to frame the hatch openings, and masts are held at the deck

Diagram exactly half size showing how widths of the planks are found



of Our New Brig Model



Pricking off a plank edge on the so-called "spiling staff"—in this case a piece of cardboard

with a touch of glue underneath and a nail through the beams.

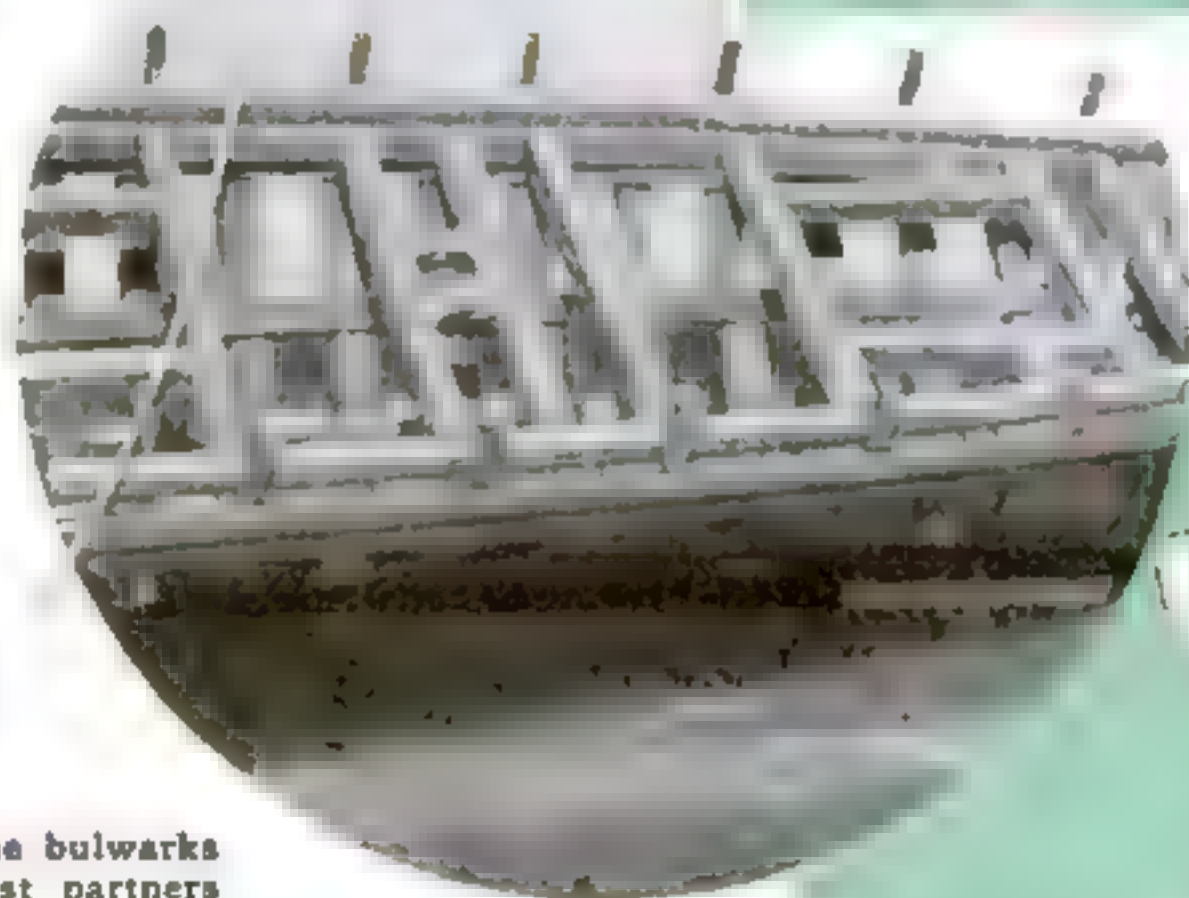
Now you may, if you wish, put in hanging (upright) knees joining all deck beams to their frames, and also lodge knees joining them horizontally, but I omitted all these.

At the stem, inside the frames, there should be several knees, hooks, beams, and the like. I combined these in one piece like a platform, $\frac{1}{4}$ in. thick, from the stem to deck beam Q. Find the shape for a tight fit by testing with a piece of cardboard. The notches (shown in a drawing last month) are to take the ends of the bowsprit bitts, which must be firm. Between beams 16 and 20 there is a carling for the capstan shaft.

Around the sides, inside the frames, filling pieces between the beams are needed to nail the the decks to. These rest on the deck-beam clamp and are a uniform $\frac{1}{4}$ in. thick by about $\frac{5}{16}$ in. wide. I fitted these tightly and glued them in position.

The temporary deck-line battens and harpings may now be removed and replaced with the permanent planks or wales. The shape of the planks is usually obtained by clamping a spiling staff to the hull. With the dividers, prick off on this the line of the plank edge; then transfer these marks to the plank for cutting. I simplified this procedure and got equally good results, as follows:

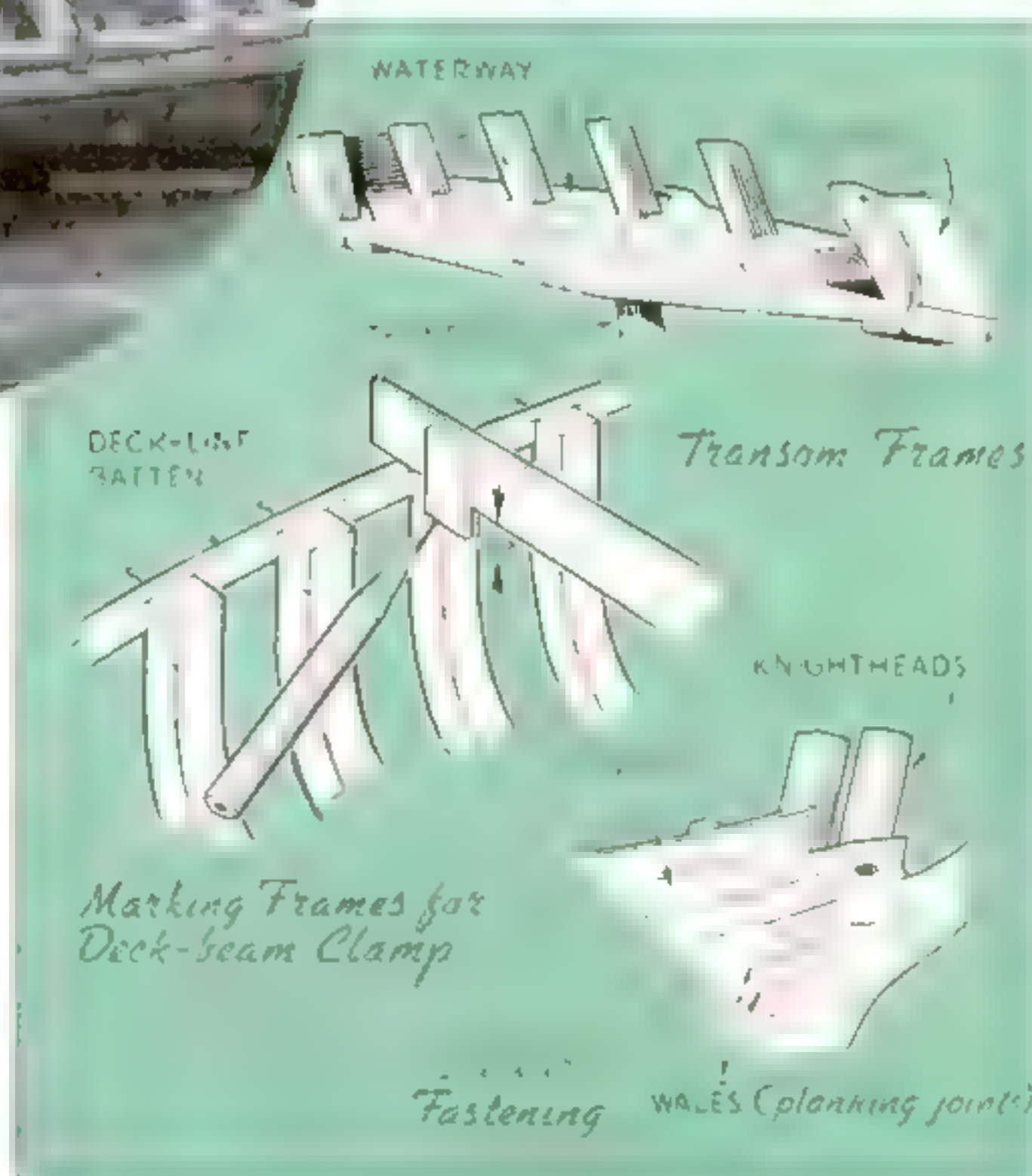
For the top strake, clamp a piece of cardboard an inch or more *(Continued on page 12)*



In circle: Waterways ready for the bulwarks and covering board. Note the mast partners



What your model will look like when finished. It is 33 in. long and 22 in. high over all

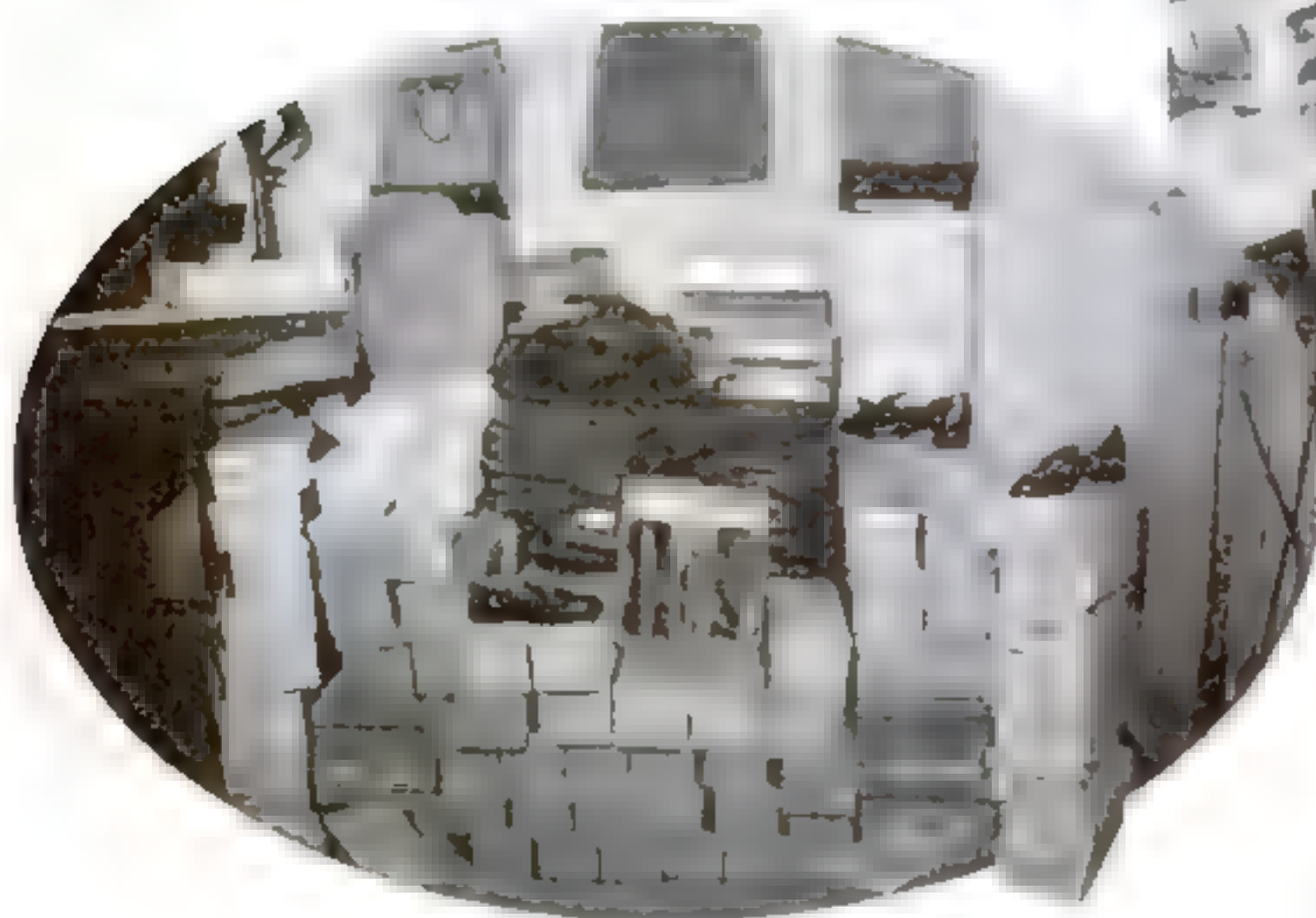


Sketches showing method of framing the transom, how main frames are marked for deck-beam clamps, and how the bulwark is fastened

The proper position for the mast steps is found by setting up temporary masts and sighting them as shown at left with a piece of cardboard cut to the required angle

Needy Children Grateful TO COUNTRY'S HOME WORKSHOPS

Guild Clubs Help the Underprivileged...Enlarge Their Programs...and Plan a Variety of Activities



Left: Shoes and clothing purchased by Jacksonville, Fla., club with funds obtained from craftwork. Above: P. R. Nalder, secretary, Coulees Dam club



Official Magazine
POPULAR SCIENCE
MONTHLY

THE care of underprivileged children is an enterprise that home workshop clubs are undertaking more and more throughout the country. One of the leaders in this movement is the *Jacksonville (Fla.) Homeworkshop Club*, which has just completed its third successful year.

Throughout the entire year, members make projects of all descriptions in their home workshops. These are exhibited annually in the windows of a large hardware store; then a public auction is held, and the money realized is used to purchase clothing, shoes, and other articles for distribution to school children through Parent-Teacher Associations and the school principals. Last Christmas 231 children were clothed.

To stimulate competition, a large manufacturer of home workshop machinery offers a prize annually for the best example of craftsmanship. D. L. Hawn won the 1936 prize with a Queen Anne whatnot, an excellent example of cabinet work.

Quarterly exhibitions, each restricted to one class of project, are held at club meetings and discussed. For example, during one quarter, wooden bowls were displayed. No two were alike in design, which proved beyond a doubt that the club's major purpose—individuality in design—has been realized.

The *Lexington (Ky.) Homecrafters* have chosen the Frontier Nursing Service, a philanthropic organization devoted to the needs of people in the mountain sec-

tion of Kentucky, to distribute the toys made each year. A new record was set up in 1936 with 350 toys distributed.

Professor L. S. O'Bannon, head of the department of mechanical engineering at the University of Kentucky, has been elected president of the club; Judge O. C. Boone is vice president, and David M. Young, curator at the university's geology museum, is secretary-treasurer. The organization plans to place every member on a series of program committees and offer a prize to the group having the most successful program in 1937.

In *Pennsylvania* the *Shenango Valley Homeworkshop Club* turned over its toys to the Sharon Sunshine Society and received an enthusiastic letter of praise from Miss Myrtle L. Allen, superintendent. "They were beautiful, well-made toys," she wrote. "To you, they meant much work and hurry; to us, they meant joy in being allowed to pass them on; and to the children and parents, they meant a Merry Christmas."

Each member of the *Pocono Homeworkshop Club of Stroudsburg, Pa.*, made six toys to give to the local Elks Club. At the meeting when the presentation was made, moving

pictures of lumbering and asbestos manufacture were shown. A recent meeting was held at the home of Warren Card, a news photographer, who demonstrated how pictures are developed and gave a talk on color work.

Programs crammed full of interesting speakers and demonstrations are bringing out a large attendance at meetings of the *Oklahoma City (Okla.) Homeworkshop Club*. As many as fourteen new members have joined at one meeting.

To illustrate how much ground is covered in a single evening, take a recent meeting: W. H. Reilly, club president, spoke on furniture design. H. W. McKimmey, head of the vocational department of the trades council of local high schools, talked on wood finishing and answered questions. This was followed by practical demonstrations of various machines and handwork under the direction of Claude Keenan, manual training instructor.

Alexander Maxwell is back again at the helm of the *Premier Homeworkshop Club of Chicago* after a lapse of about a year. Lester Wise is vice president; Emil Brasholz, treasurer; Henry Wagner, secretary.

The club has experts in many lines, and these members have been designated to answer ques-



Queen Anne whatnot which won annual prize for best work awarded by Jacksonville Homeworkshop Club

(Continued on page 109)

\$80,000 — Awards for boys in the United States

Fisher Body Craftsman's Guild announces TWO competitions for 1936-37 of which one is new and entirely different

- Four \$5,000 University Scholarships
- 882 Cash Awards Ranging from \$25 to \$100
- 36 Trips to the 1937 Guild Convention
- 922 AWARDS IN ALL!

Here is the biggest and most interesting news that you have read in a long time. If you are from 12 to 19 years of age, you are eligible to try for a university scholarship, or for one of

the many cash awards, or one of the all-expense-paid trips offered by the Fisher Body Craftsman's Guild in these two competitions.

There are TWO competitions THIS year!

1. Napoleonic Coach Competition

The Napoleonic Coach project remains the same as it has been for the past 6 years. In it, you build a miniature model Napoleonic Coach to the same specifications as in the past. In this competition forty-nine boys have won scholarships ranging from \$500 to \$5000 during the past six years. This year, there are state and regional awards which add to the interest of the competition.

2. Model Car Design Competition

The Model Car Design competition is new and will appeal to all of you who would like to try your hand at something different. You start from scratch here. All you have to do is fashion a miniature automobile embodying your own ideas of motor car design. This competition has to do only with the outside appearance or design of the car.

So send in the COUPON at once

The requirements are simple. Decide now whether you choose to build the Napoleonic Coach or a modern automobile of your own design. Then fill out and mail the coupon for membership in the Fisher Body Craftsman's Guild.

As soon as we hear from you, we will send you free of charge your membership card, the official Guild button, and all the scale drawings, specifications, and instructions you will need to construct either the Napoleonic Coach or the scale model automobile of your own design.

These drawings, specifications, and instructions show everything to do in making your coach or car—step by step. You can't go wrong.

But the more time you have, the better job you can do. Don't wait. Fill out the coupon now, tear it out, and mail it at once.

There are no dues or fees. Guild membership and competitions are open to all boys in the United States between the ages of 12 and 19 inclusive.

\$80,000 in Scholarships, Cash and Trips. 922 Awards

1 Napoleonic Coach Competition 216 Awards, Cash Value, \$32,650

Grand National Awards TOTALS
1 Junior and 1 Senior, 2 Scholarships—
\$5,000 each \$10,000

1st State Awards

1 Junior and 1 Senior, in each of the 48 states and District of Columbia—
\$100 each \$9,800

2nd State Awards

1 Junior and 1 Senior, in each of the 48 states and District of Columbia—
\$75 each \$7,350

18 Regional Awards

A trip to the 1937 Guild Convention for 9 Juniors and 9 Seniors.

2 Model Car Design Competition 706 Awards, Cash Value, \$47,350

Grand National Awards
1 Junior and 1 Senior, 2 Scholarships—
\$5,000 each \$10,000

1st State Awards

1 Junior and 1 Senior in each of the 48 states and District of Columbia—
\$100 each \$9,800

2nd State Awards

1 Junior and 1 Senior in each of the 48 states and District of Columbia—
\$75 each \$7,350

3rd State Awards

1 Junior and 1 Senior in each of the 48 states and District of Columbia—
\$50 each \$4,900
Four cash awards of \$25 each for both Junior and Senior in each of the 48 states and District of Columbia..... \$9,800

18 Regional Awards

A trip to the 1937 Guild Convention for 9 Juniors and 9 Seniors.

Rules and Regulations

In both competitions, the following regulations will prevail. Boys 12 years old or older, and not yet 16 on September 1, 1936, compete in the Junior division. Boys 16 years old or older, and not yet 20 on September 1, 1936, compete in the Senior division. All boys within these age limits are eligible for Guild membership. There are no dues or entrance fees of any kind. Each member shall receive, without charge, an Official Guild membership card and button, and a full set of Guild drawings and instructions. The Napoleonic Coach competition closes August 2, 1937 at midnight. The Model Car Design competition closes July 1, 1937 at midnight.

FISHER BODY CRAFTSMAN'S GUILD

8-167 General Motors Bldg., Detroit, Michigan.

Gentlemen: Please enroll me in the Fisher Body Craftsman's Guild for 1937 in the

- ☐ Napoleonic Coach Competition.
☐ Model Car Design Competition.

Also please send me my official membership card, button, and full instructions, free of charge.

Name.....

Address.....

City..... State.....

I was born on the day of..... 19.....

Be sure to check the class in which you wish to be enrolled.

FISHER BODY CRAFTSMAN'S GUILD

An Educational Foundation sponsored by General Motors
GENERAL MOTORS BUILDING • DETROIT, MICHIGAN

Tricks to Help MOTORISTS

THESE SUGGESTIONS FROM READERS
MAY SAVE YOU TIME AND MONEY

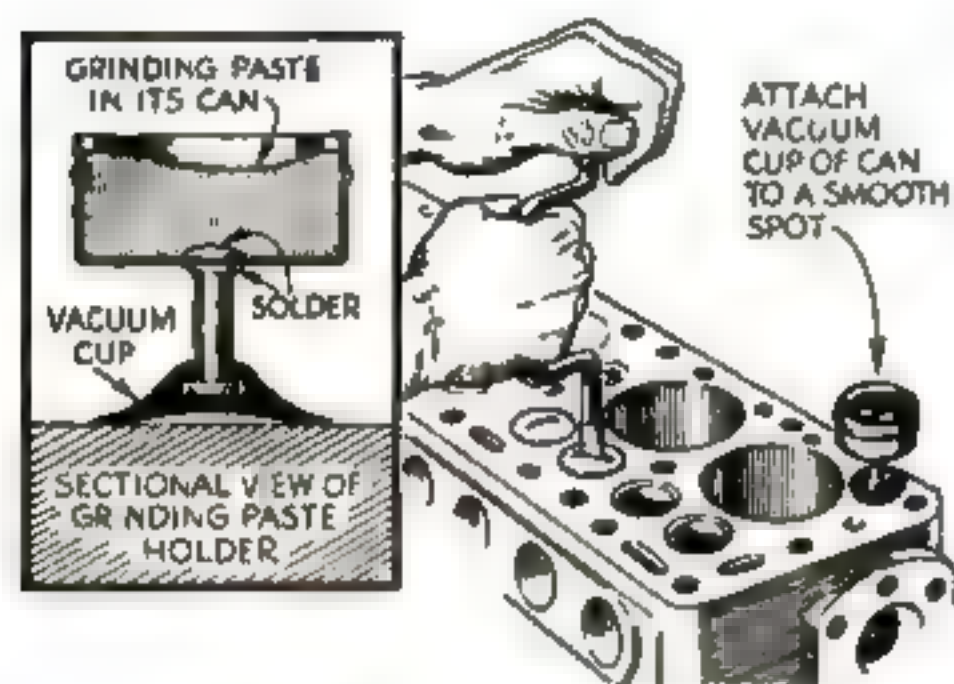
Test Tank Locates Fuel-Line Troubles

FUEL-SYSTEM troubles can be located easily with an auxiliary gasoline reservoir consisting of a tin can and a length of copper tubing fitted with a gas-line coupler. In use, the gasoline-filled can is connected first to the carburetor in place of the regular line. If the motor fails to start, it shows

that the carburetor is causing the trouble. If the motor starts, the trouble is elsewhere, and the can is then connected to other parts of the fuel system until the trouble is found.—H. A.

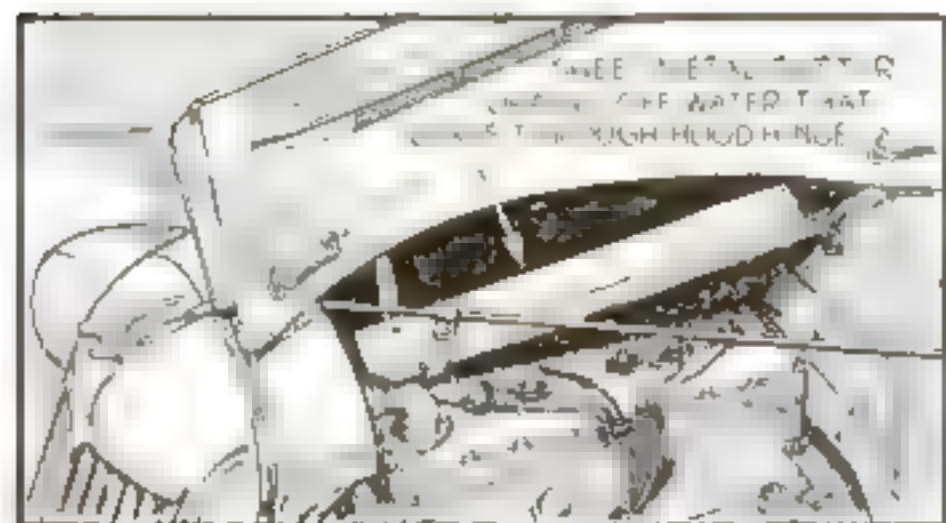


Testing a carburetor with an auxiliary fuel tank consisting of a tin can and a tube fitted with a gas-line coupler



Can With Suction Cup Holds Valve Compound

WHEN SURFACING valves, it is often difficult to know what to do with the container of grinding compound. In the kink illustrated above, the can is provided with a suction cup that allows it to be fastened to any flat surface on the motor. The suction cup can be mounted on the bottom of the can with a short bolt, or by means of a length of tubing or drill rod soldered in place.—A. H. W.



Automatic Seat Prop for Two-Door Sedans

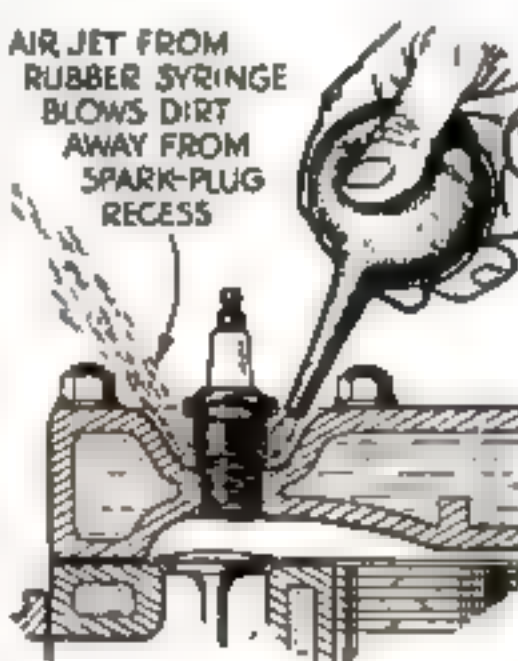


How the prop holds the front seat up to allow easy access to the rear of a two-door sedan

TO ELIMINATE the bother of holding the front seat up when passengers are entering the rear of my two-door sedan, I bolted a hardwood prop to the outside, rear leg of the seat, as shown at the left. When the seat is raised, the prop automatically slides into position, while a tap with the foot slips it forward and allows the seat to drop into riding position.—H. S.

Syringe Removes Dirt from Spark-Plug Bases

IF SPARK plugs are unscrewed without first removing the dirt that collects around their bases, there is danger that the grime will drop down into the cylinders. As a precaution, I unscrew each plug a few turns and then blow the collected dirt away with an old ear syringe.—P. E. V.



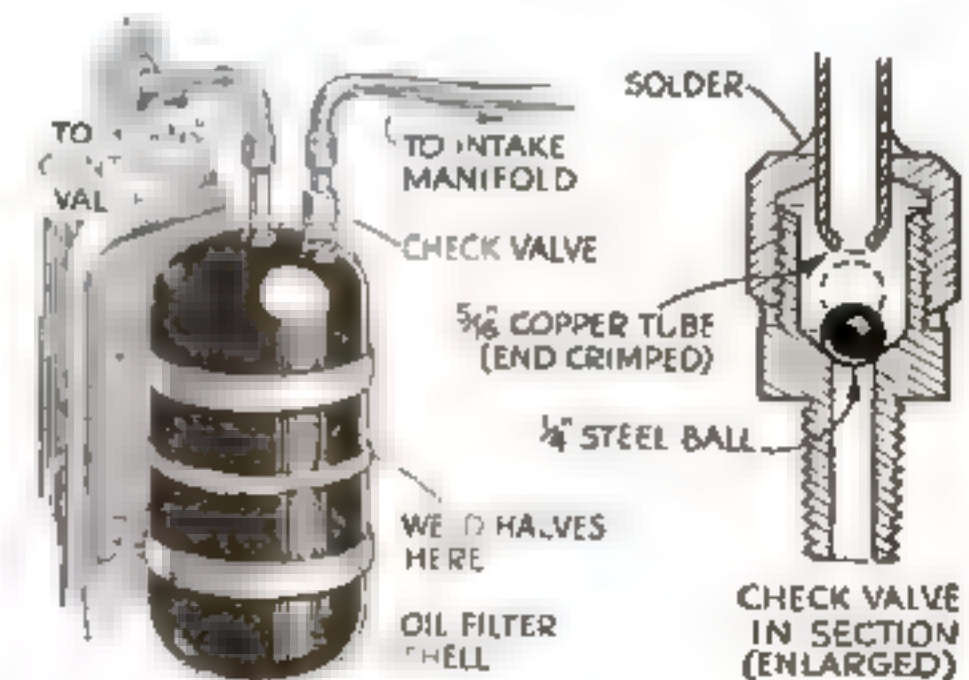
An ear syringe proves a handy cleaning tool for removing the dirt around spark plugs

Water Drain Under Hood Protects Top of Motor

ON CARS having center-hinge hoods, water is very likely to drip down over the motor during heavy rain storms. The spark plugs and ignition wires can be protected, however, by installing a V-shaped, sheet-metal trough to catch the water, as indicated at the left.—E. R. W.

Windshield Wiper Shows Motor Efficiency

BECAUSE most windshield wipers are operated by the vacuum created in the intake manifold, they provide an excellent indication of just how efficiently the motor is operating. By watching them during rainy weather, and feeding the gasoline in such a way that they always operate at close to top speed, you can train yourself into good fuel-saving habits. Maximum gasoline mileage is obtained when the vacuum in the intake manifold is not decreased to a point where it materially affects the speed of the wiper.—W. T. M.



Vacuum Tank for Horn

AFTER installing an inexpensive vacuum horn on my car recently, I found that it would not operate when the car was accelerated. Deciding that a vacuum-storage tank was necessary, I made one from an oil-filter shell, with a compression connector and a ball bearing as a valve.—J. D. D.



Herb Lewis of the Detroit Red Wings says:
"I go for Camels in a big way!"

THE lightning-quick camera eye caught *Herb Lewis* (above, left) in this slashing set-to before the goal. Next split-second he scored! After the game (right), Herb said: "You bet I enjoy eating. And I'll give Camels credit

for helping me enjoy my food. Smoking Camels with my meals and afterwards eases tension. Camels set me tight!"

Camel smokers enjoy smoking to the full. It's Camels for a "lift." It's Camels again "for digestion's sake." Thanks to Camel's aid, the flow of the important digestive fluids —alkaline digestive fluids—speeds up. A sense of well-being follows. So make it Camels—the live-long day.

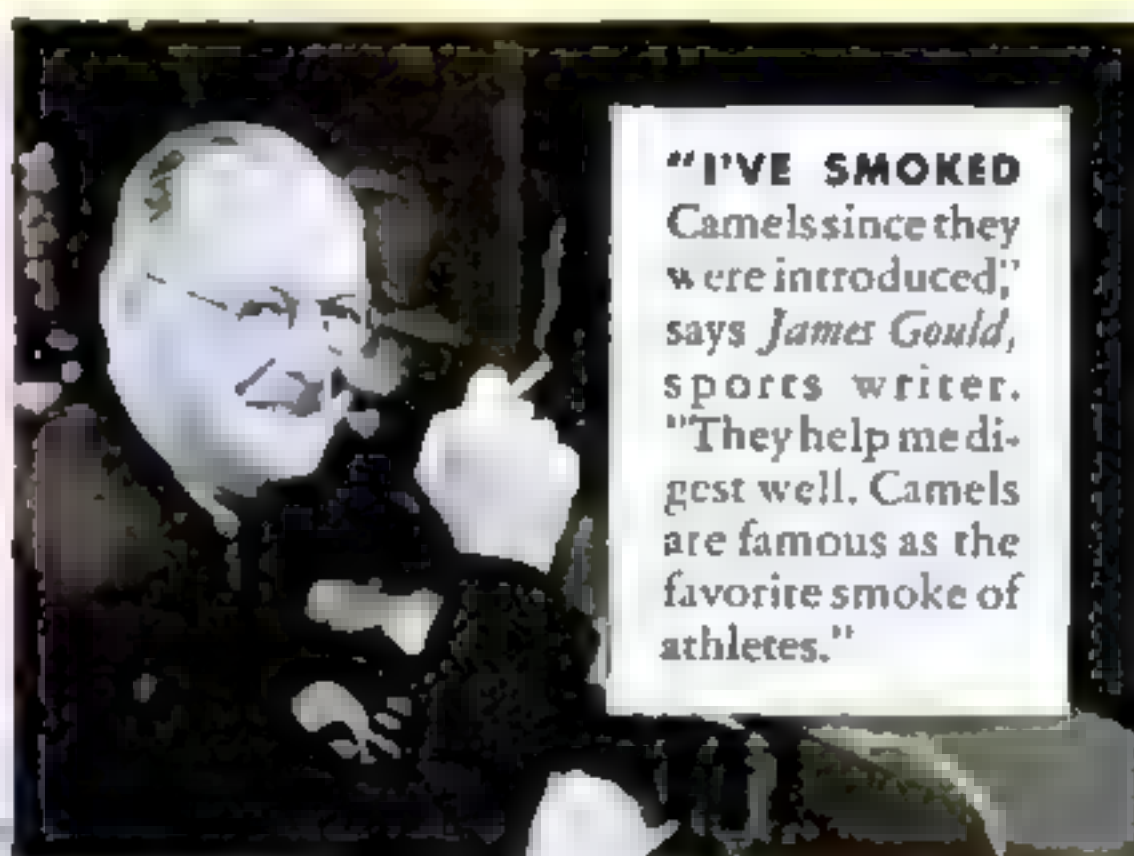
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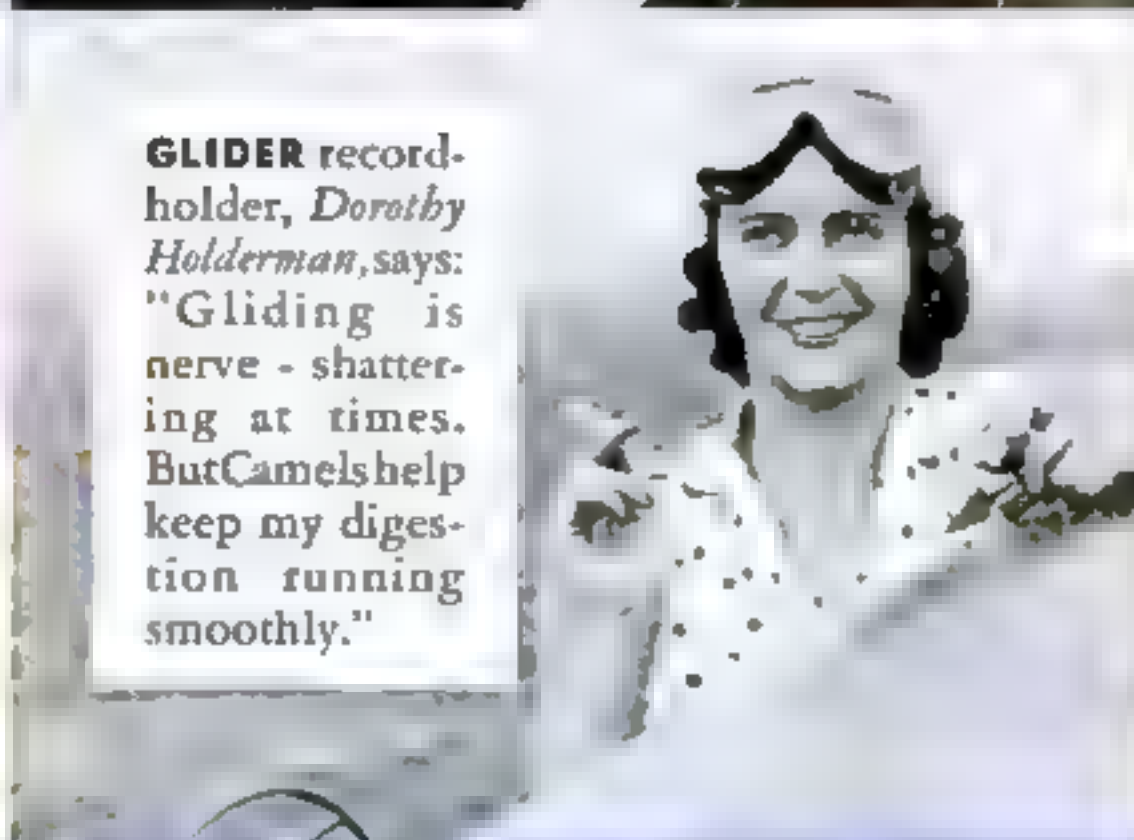
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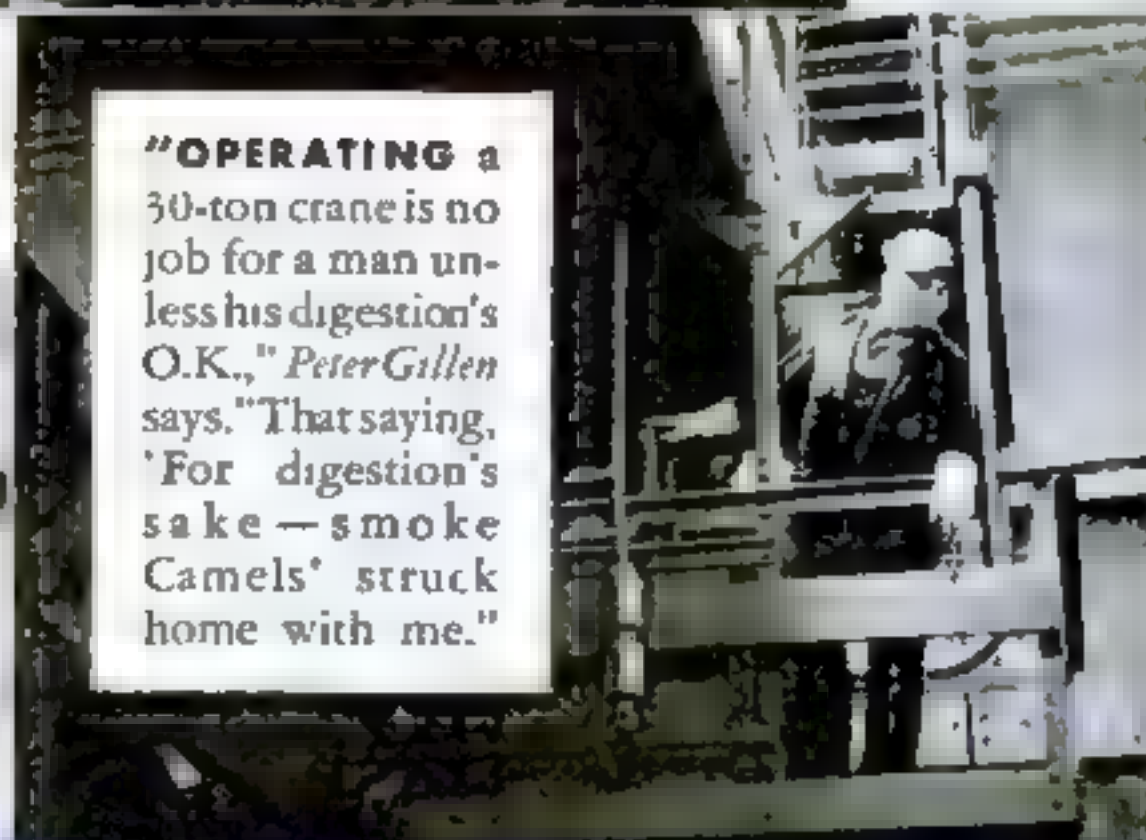
"I'VE SMOKED Camels since they were introduced," says *James Gould*, sports writer. "They help me digest well. Camels are famous as the favorite smoke of athletes."



"MY DIGESTION keeps on an even keel," says sea-going Chief Engineer, *George Buckingham*. "Smoking Camels at mealtime and after helps me enjoy my chow."



GLIDER record-holder, *Dorothy Holderman*, says: "Glidering is nerve-shattering at times. But Camels help keep my digestion running smoothly."



"OPERATING a 30-ton crane is no job for a man unless his digestion's O.K.," *Peter Gillen* says. "That saying, 'For digestion's sake—smoke Camels' struck home with me."

FOR DIGESTION'S SAKE — SMOKE CAMELS!



A few pencils, a book of spotting colors and a small brush, some paper stumps, mucilage, a knife, and a magnifying glass are the essentials of a print-retouching outfit

How to Retouch Your Own Photos

Simple methods of hiding spots and blemishes that often mar otherwise satisfactory prints

By KENNETH M. SWEZEY

TO THE beginner in miniature-camera photography, or in any branch of photography where enlargements of more than a few times must be made, one of the greatest sources of discouragement is the problem of spotty prints. Otherwise excellent pictures are often spoiled completely by spots and curlicues of white and dots of black. Even contact prints sometimes suffer from these defects.

Some blemishes may come from careless processing of the negatives; the remainder are due to perverse threads of dust that settle on the negative, cover glasses, or condensing lens during enlargement. Spots of the first kind may be minimized by using more care in the finishing. Those that are left may be removed, or concealed so as to defy detection, by retouching.

A print-retouching outfit may be assembled for less than a dollar. The essentials consist of two or three common graphite or "lead" pencils (2H, HB, and 2B make a good assortment), a small camel's-hair or sable brush, several carbon pencils (H, B, and 2B), a few paper stumps, a book of spotting colors, an etching pen

(all obtainable from any large photographic store or supply house), and a little mucilage. A pocketknife and a small magnifying glass are handy accessories.

The principle of camouflaging a spot

consists either in building up or cutting down its tone to match the tone of the picture immediately surrounding it. At the same time, the retouching medium must match as nearly as possible the surface reflection of the type of paper being used.

Before attempting any retouching, be sure that the print is thoroughly dry. Work under a fairly strong light, and examine your retouching frequently from different angles. Except on very fine details, or for etching, it is more satisfactory to work with the naked eye.

For the beginner, carbon-pencil and lead-pencil retouching is probably the easiest. The first, making a dead gray or black mark, is ideal for matte paper and some of the rougher papers. Lead-pencil marks are practically invisible on so-called "velvet" and other papers having a semigloss. Keep the pencils sharp and use the one nearest in shade to the surroundings of the spot to be hidden.

Perhaps a single deft touch of the pencil point will make a small white spot invisible. If the mark is too black or stands out too sharply, it may be toned down and blended with a paper stump or the tip of *(Continued on page 103)*



A light-colored area in the enlargement above is being built up to match the surrounding gray tone by means of powdered graphite put on with a paper stump, which is a pencil-shaped tool made for blending



One way to hold the etching pen in order to have good control over movement and pressure. The thumb supports the weight of the hand, and a wrist motion is used



Spotting colors, from black to gray, are spread out on a plate or porcelain palette so that the correct tone may be selected almost at a glance

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(Construction kits are available for some of these models. See page 18.)



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Outboard Racer for Class "A" and "B" Motors, (10 ft. 4 in. long), 211-212-R	.75
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MOLTEN LEAD FASTENS CHISELS IN HANDLES

EVERY instructor of shopwork or home mechanic who is bothered with keeping handles on wood chisels and turning tools can anchor them securely with melted lead.

The shank of the tool will first have to be notched. I do this on the corner of an old emery wheel, which I keep for this purpose. Then I drill a hole in the handle equal to the largest part of the shank. From the outside of the handle, I bore a pouring hole about $\frac{3}{8}$ in. in diameter. It is advisable to heat the shank somewhat before inserting it in the handle. A little soft soap or putty should be put around the end of the handle to keep any lead from running out. A small funnel of putty may be formed around the opening to aid an unsteady hand. Put a $\frac{3}{8}$ -in. dowel in the hole, shape the putty around it, and in removing the dowel rotate it to form the funnel.—EDMUND C. HANLEY.

DRAFTING PRICKER MADE FROM CROCHET HOOK

A BROKEN steel crochet hook, if sharpened to a point, makes an excellent pricker for drafting use. The flattened portion of the handle affords a good finger grip and also prevents the tool from rolling when laid down on a sloping drawing board.



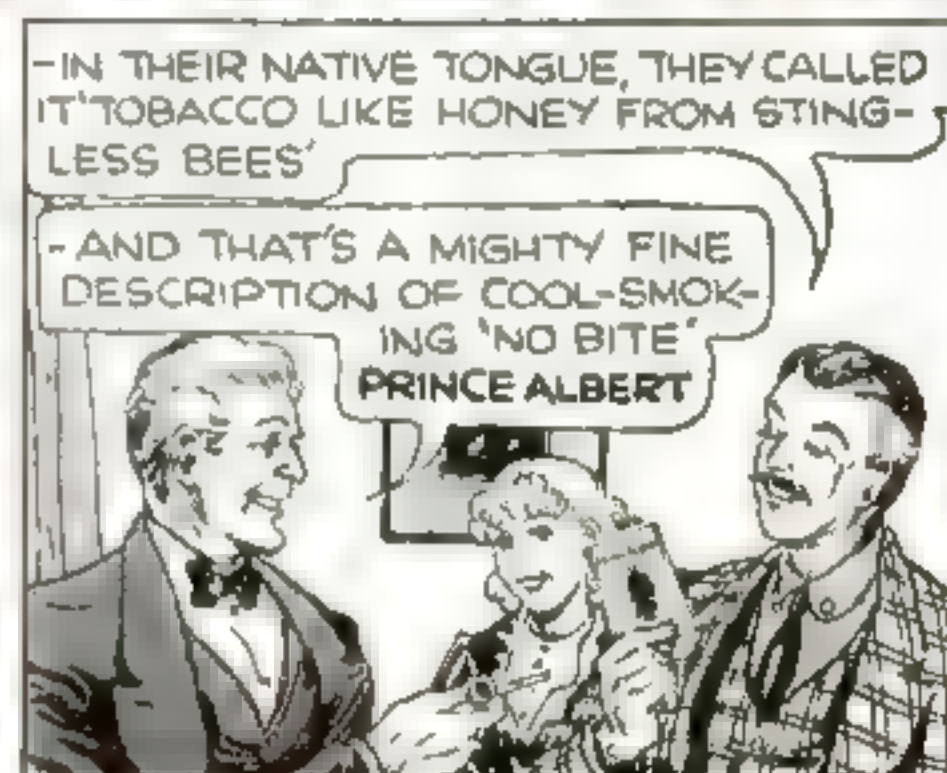
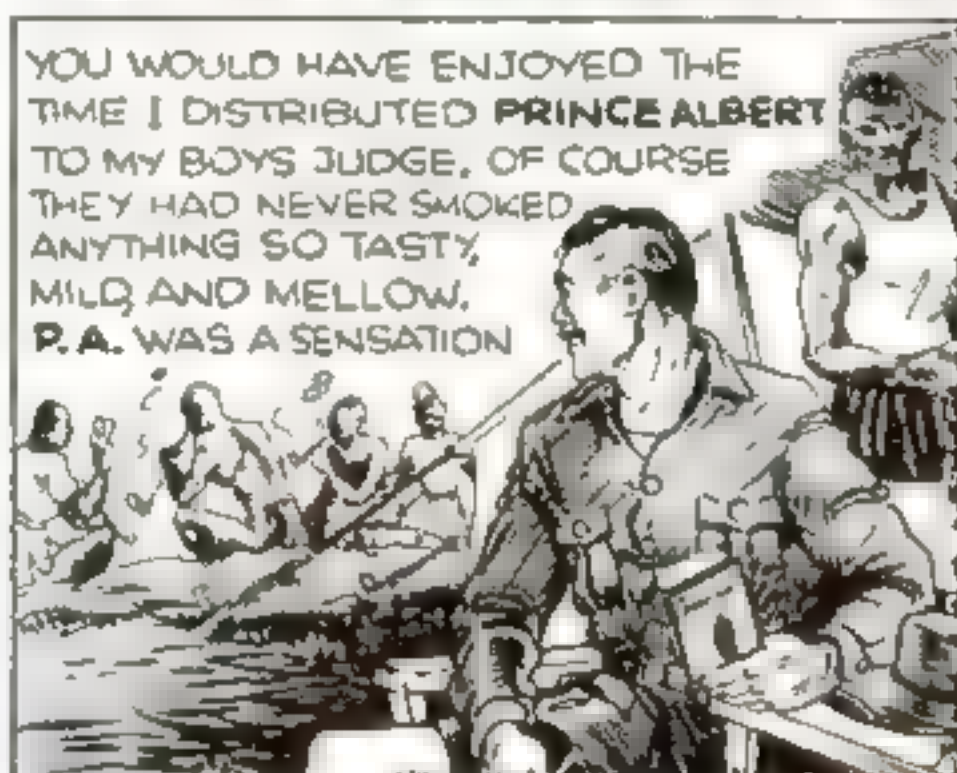
PUNCHES AND CHISELS TEMPERED BY COOLING IN DAMP EARTH

IN REFORGING broken punches or chisels and making new ones, the most difficult part of the task is tempering them properly. The method of judging by the colors is not easy unless one is experienced. Another way that does not require any skill yet often proves satisfactory has been known to blacksmiths for many years, although the average amateur has not heard of it. Heat the portion of the tool to be tempered to a cherry-red color; then quickly carry the tool out of doors and drive the heated portion several inches deep into the moist ground. When completely cool, remove the tempered tool from the ground and polish it.

This method, however, may not work with some special types of steel or if the tool has been broken off too far.—GAIL M. FOSLER.

YOL' JUDGE ROBBINS

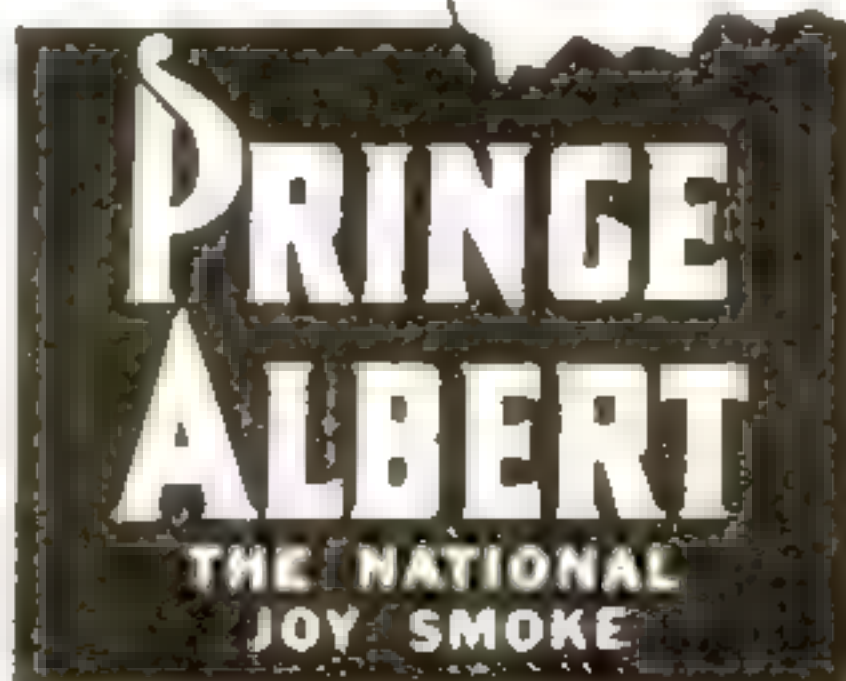
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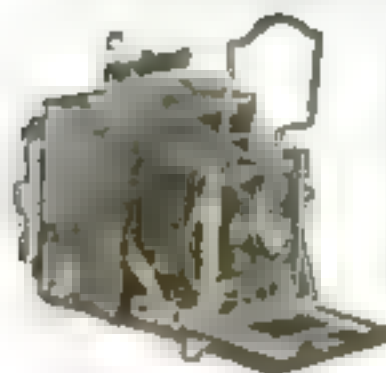


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in an enlarger in place
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By LYNWOOD
M. CHACE

Noted Nature Photographer



This remarkable picture of an oak leaf was made by placing a leaf in an enlarger and exposing it as if it were a negative

FOR anyone interested in photography there is no limit to what can be done by experimenting with photographic materials.

Trying to photograph a cricket beneath a clump of foliage one day, I happened to notice the interesting design caused by the sun's rays as they shone through a leaf from the opposite side. This suggested to me that if the sun's rays could bring out this design in such a way, the same effect could be obtained by putting the leaf into the negative holder in my enlarger and projecting a 100-watt light through the leaf.

I immediately collected several kinds of leaves and insect wings and took them to my darkroom. My first experiment was with an oak leaf, which I placed between the glass of the negative rack of the enlarging camera, where the negative ordinarily would go. Much to my surprise and satisfaction, I got the very same effect I had seen.

I then took a sheet of 8 by 10-in. enlarging paper, bromide No. 1, which is glossy and contrasty, and put it into an 8 by 10-in. printing frame, focusing the leaf fine and sharp, so that it filled up the whole paper. The exposure was then made.

Soon after the paper was put into the developer, a faint outline of the leaf began to appear. In a short time the whole leaf took shape, and when properly developed the print was put into the hypo. I was convinced then that I had discovered a new and unique photographic effect.

Above: The picture is made on a glossy, contrasty bromide paper. Right: The leaf is placed between the glass sheets of the negative rack. Below: Examples of the countless amazing nature studies that can be prepared in this way



HOW TO RETOUCH PHOTOS

(Continued from page 98)

the forefinger. For a larger spot, the area must be covered by applying the pencil point with a light, irregular jiggling motion. Build up the correct tone by interlacing the light lines, and finally blend once more with the stump or forefinger.

For still larger spots, or for large areas in a picture that would look better darkened, graphite or carbon may be more evenly applied with a stump. Fine scrapings from a pencil of the proper type and degree of hardness are spread out on a piece of cardboard, and the stump is charged with them. The blackness and freedom from grit should be tested on a piece of plain paper before applying the stump to the print.

FOR pictures that will be subjected to much handling, and for certain special types of paper, spotting colors may be more satisfactory. These are opaque water colors obtainable in black, white, and sepia.

On black and white prints, black will be the only color needed. Used with plain water, the color dries with a dull matte finish, and in this form matches the matte paper. By adding mucilage to the water in varying amounts, it may be caused to dry with a degree of gloss that will match practically any photographic paper. Even ferrotyped paper, the most difficult paper to retouch, may be spotted almost invisibly by the use of spotting color mixed in water containing the correct amount of mucilage.

Clean retouching with spotting color requires that the proper tone be applied at once. A white porcelain palette—an ordinary luncheon plate is suitable—on which your color may be spread out in a band that ranges, by dilution, from black to light gray, makes the selection of the proper tone just a matter of quick comparison.

If you are working on dull paper, use ordinary water for a medium; if on shiny paper, experiment by adding small amounts of mucilage to the water until the color dries with a gloss comparable with that of the paper. Wet the brush just sufficiently for the color to flow. If it is too wet, a spot will dry, leaving a dark ring with a light center.

ETCHING, the removal or toning down of dark spots by scraping the emulsion, is the most difficult branch of print retouching. Patience is perhaps the chief requisite. The problem before you is to scrape down gently the color-bearing emulsion without damaging the surface or the texture of the paper.

The correct way to hold an etching pen is largely a matter of personal preference. In the method shown in one of the illustrations, good control of the pressure of the blade is obtained by scraping with a slight wrist motion, sustaining the weight of the hand on the side of the thumb. Some photographers prefer to hold the etching pen between the thumb and forefinger, as one would an ordinary pen. Regardless of the method used, the aim is to limit the etching to the area and degree desired, and to avoid cutting into the paper.

The blade should be kept sharp. In use it should be held almost at right angles to the paper. In order to see exactly what you are doing, it is safer to use a magnifying glass to inspect the progress. Always scrape lightly, so lightly that no single stroke seems to make an individual mark. Stop as soon as the spot reaches the tone of the surrounding picture. If the spot is not large and is on semimatte paper, the work will be practically invisible. On glossy papers an etched place will stand out conspicuously as a dull spot when viewed from an angle. This dullness may be largely overcome by touching the spot with a brush dipped in clear mucilage water.



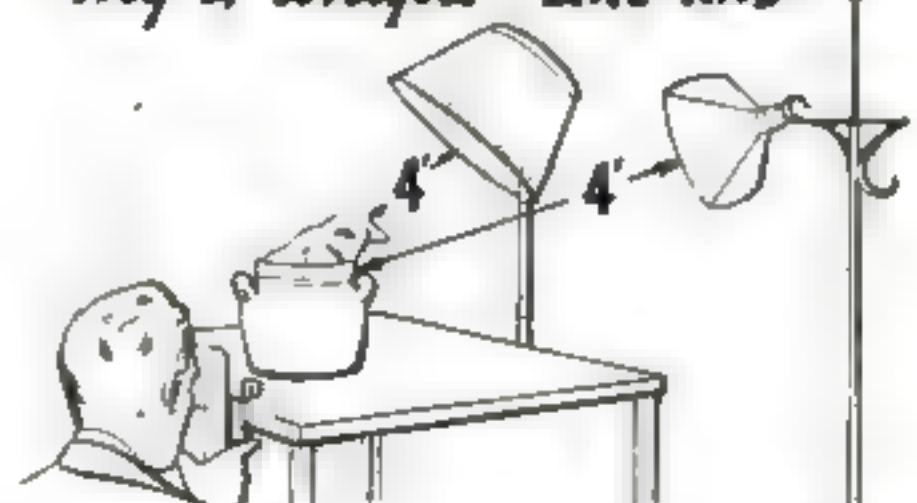
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**BURNING
CHIN** *problem*

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You owe it to yourself to find out which Mennen Cream fits *your* face. Send 10c for the Mennen Skin Tester Kit, containing demonstration sizes of 5 Mennen Products—including both Mennen Lather Shave and Brushless (as well as Skin Bracer, Skin Balm and Talcum for Men). Address Dept. P.S.1, The Mennen Company, Newark, N. J.



HOW TO DO DECORATIVE WIRE WORKING

Con't nued from page 87



Drawing wire through a typical commercial drawplate with a variety of round, half-round, and square holes

escapement files can be obtained in round, square, triangular, and other shapes. Use merely the point of the file for shaping the smallest hole; for the next larger hole, sink the file a fraction of an inch deeper, and so on. Smooth up each one to reduce friction. A cone-shape opening is most satisfactory.

To restore the hardness of the metal, wrap the plate with several turns of iron wire, then suspend it over a gas flame until it is an even red. Immediately plunge it into a pail or pan of cold water. To temper, cautiously reheat it until the steel takes on a straw-yellow color, then again plunge it into water. Clean a part of the surface with emery cloth to see the color better.

Special drawing tongs are made for this work, but it is satisfactory to use ordinary pliers if the mouth is first filed smooth and flat. The end of the wire to be drawn must be filed to a point, and the whole wire should be well oiled.

By drawing it through successively smaller holes, the wire will become springy. Care must be used to avoid injury in case the end springs back after leaving a hole. The springiness indicates that the wire requires annealing. Short lengths can be annealed by drawing them slowly through a gas flame, allowing them to become red. To anneal considerable lengths, it is best to make the wire into a coil and suspend it over the flame with a piece of iron wire. A short dip in nitric acid will remove the coating of black oxide, but this need not be done until the wire is of the size wanted.

Annealing is necessary before twisting, which is the method used to make the wire decorative. While the wire or a combination of two or more wires could be twisted by hand, a more practical way is to use a lathe with a hollow headstock spindle. First cut a 1-in. thick wood disk, drill a hole through



the center, and then screw it to a faceplate with a center hole so any length wire can pass through. To the face of the disk, screw a C-clamp so that the jaws meet at the center of the hole. Cut a slot in the knurled screw head of the clamp to enable it to be tightened with a screw driver. A further refinement is to attach a strip of light spring brass to the headstock bearing case so as to engage a pin driven into the back of the wood disk, near the edge. This will cause an audible click so that the turns may readily be counted. In twisting the wire, it is merely gripped with the C-clamp as illustrated, and the other end seized with pliers. The lathe must be operated by hand, and an easy way is merely to pull the belt downward.

In addition to changing the shape of wires for decorative purposes, the drawplate has another very important use in every workshop—it makes unnecessary the stocking of a large assortment of wire in the different gauges. If you require a piece of fine copper wire, for instance, there is no need to grope in the junk box or rush to the nearest hardware store and purchase a spool. Merely clean the insulation from 1 ft. of common electric wire, pass it through the drawplate a few times, and you will have from 10 to 20 ft. of wire of the exact size required for any particular job.

Many decorative novelties may be constructed at low cost by using twisted wire. If you would like additional articles to be prepared on this subject and published in future issues, please send a post card to the Home Workshop Department



Square wire twisted, passed through square drawplate hole... same, passed through round hole... square wires twisted together... twisted, wound on wire, and removed

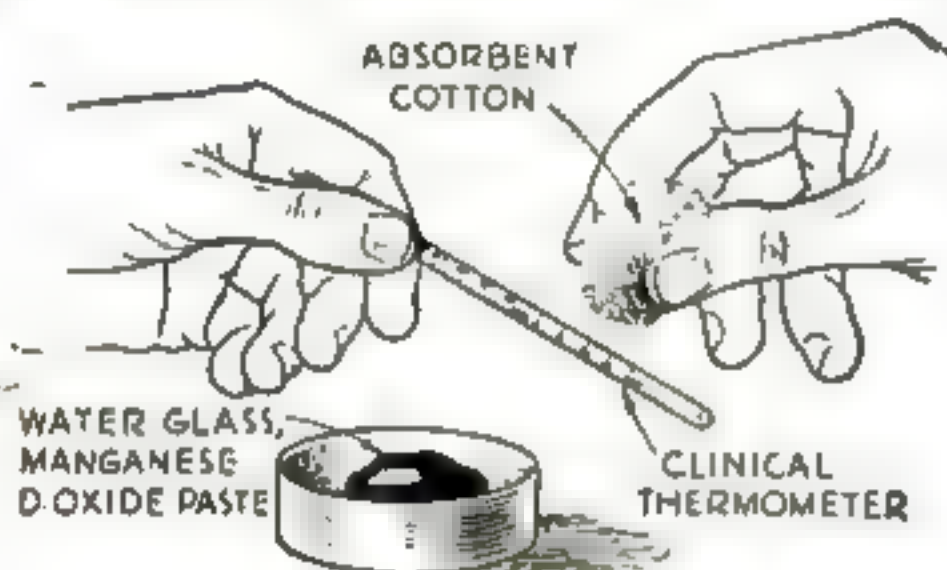


Half-round wire twisted, drawn through round hole... with loose twist... with twists alternating... twisted, then wound with square twisted wire. Left: Annealing a coil of wire to soften it before twisting

Shipshape Home Ideas for APRIL

WITH the coming of spring, there are many odd jobs to be done about the home. A few suggestions for April follow:

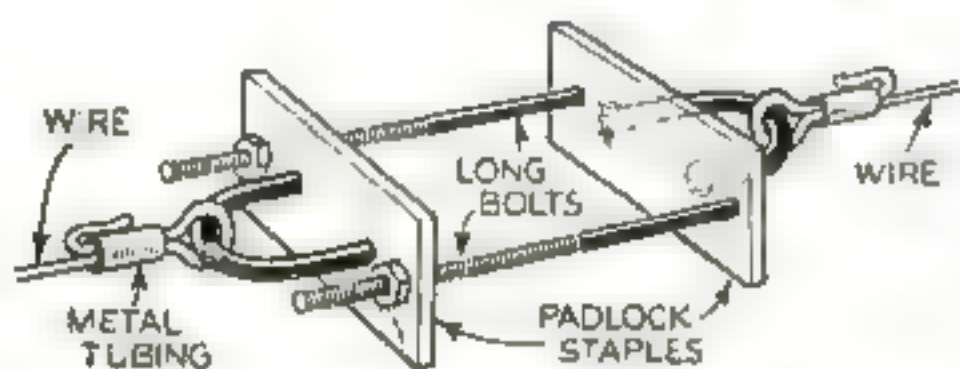
- Replace broken or decayed porch steps and railings.
- Calcimine ceilings.
- Build breakfast nook.
- Repair or replace gutters, leaders, and flashings.
- Enlarge existing garage for an extra car or build new garage, if needed.
- Examine screens. Mend holes, paint frames and mesh also, if made of wire that will rust.
- Build bird houses, window boxes, trellises, and other outdoor accessories.
- Modernize existing bathroom with new wall treatments, flooring, fixtures, medicine cabinet, and the like.



RELETTERING CLINICAL THERMOMETERS

CLINICAL or laboratory-type thermometers can be relettered to read legibly by filling in the engraved numbers and marks with water glass and manganese dioxide, or even charcoal. It is best to grind the two together in a mortar to make a paste. With a pledget of absorbent cotton, swab the pasty pigment across the thermometer and wipe off the excess with a clean pledget of cotton. Allow to dry overnight.—R. W.

IMPROVISED TURNBUCKLE HAS LONG TAKE-UP



Two common padlock staples clamped together with long threaded bolts can be used as shown to serve as a turnbuckle. If the bolts are long enough, the wire can be taken up more than with the ordinary turnbuckle.

SAILS FOR SHIP MODELS

MANY ship model builders have a hard time finding cloth that is sufficiently fine to use as sails on an accurately detailed model. I have found that ordinary draftsman's tracing cloth, with the stiffening ingredient boiled out, is excellent. Being thin and closely woven, it looks like real sailcloth "scaled down." New tracing cloth can be used, but it will be found just as satisfactory to use old tracings, as the ink will wash away with the filler. It should be lightly starched and ironed before being cut to size.—H. V. L.

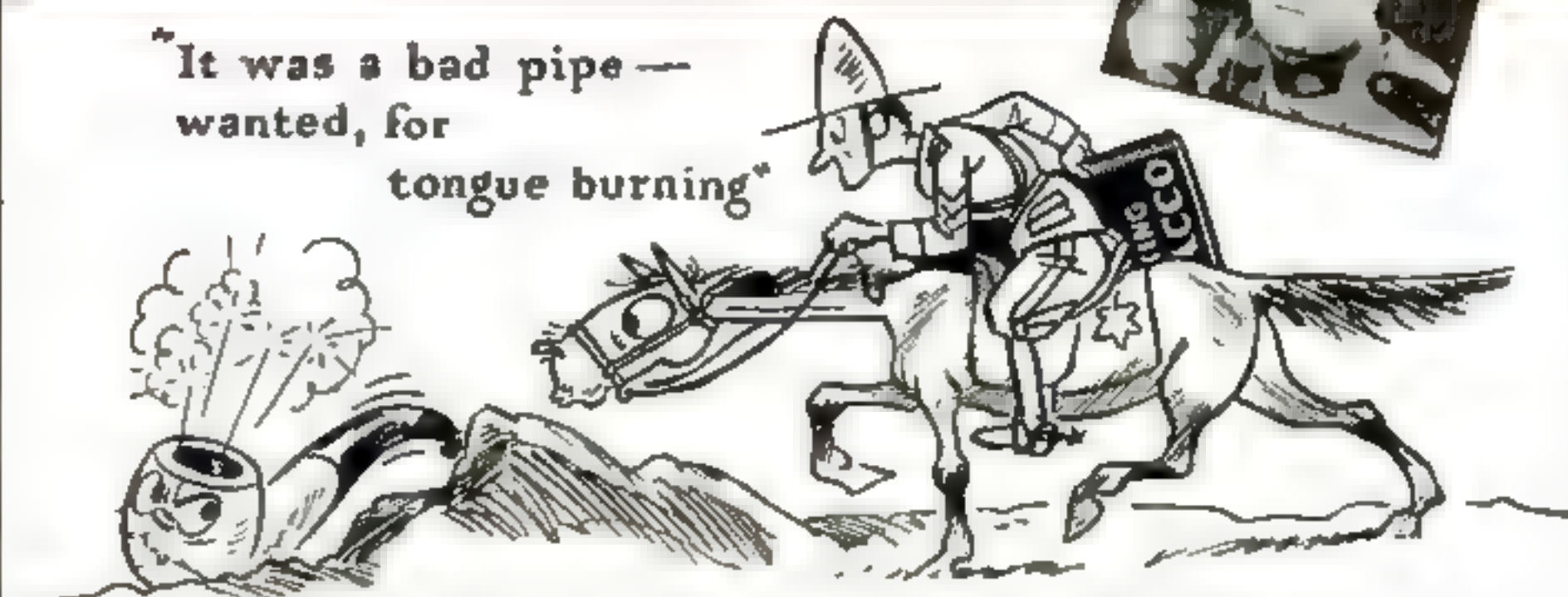
"How I Reformed an Outlaw Pipe"

by ROYAL N. WEST

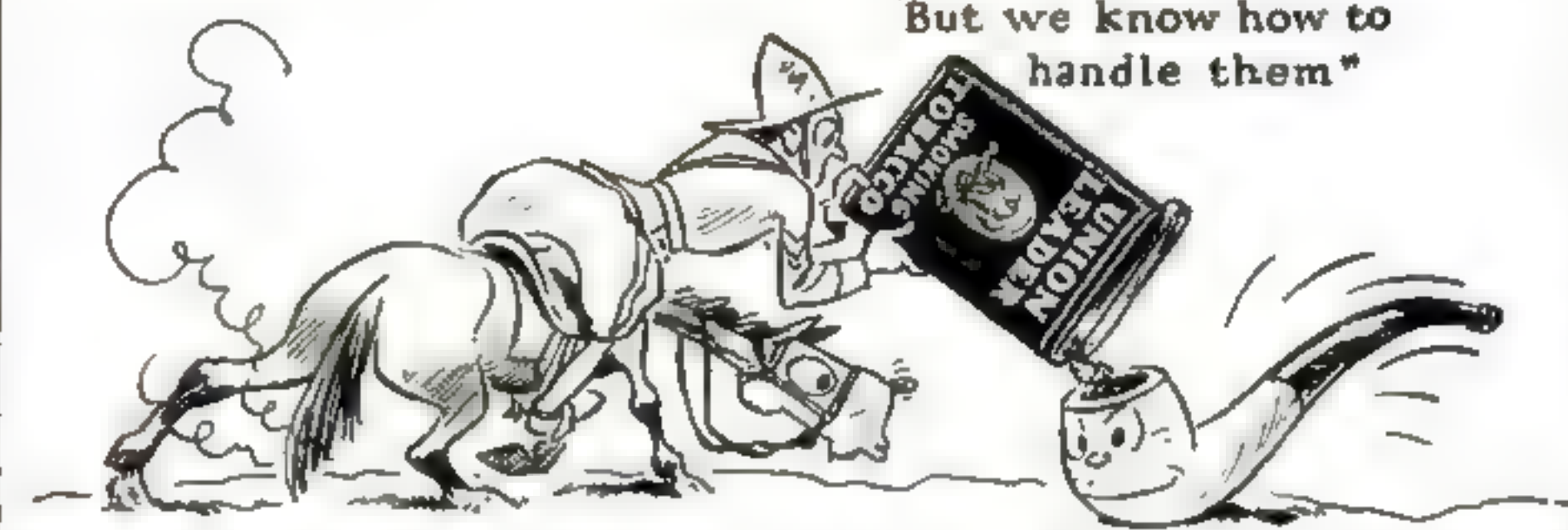
"MOUNTIE"



"It was a bad pipe — wanted, for tongue burning"



"But we know how to handle them"



"Now a good citizen — thanks to Union Leader"



You too, can be a Pipe-Tamer

THIS EASY, INEXPENSIVE WAY!

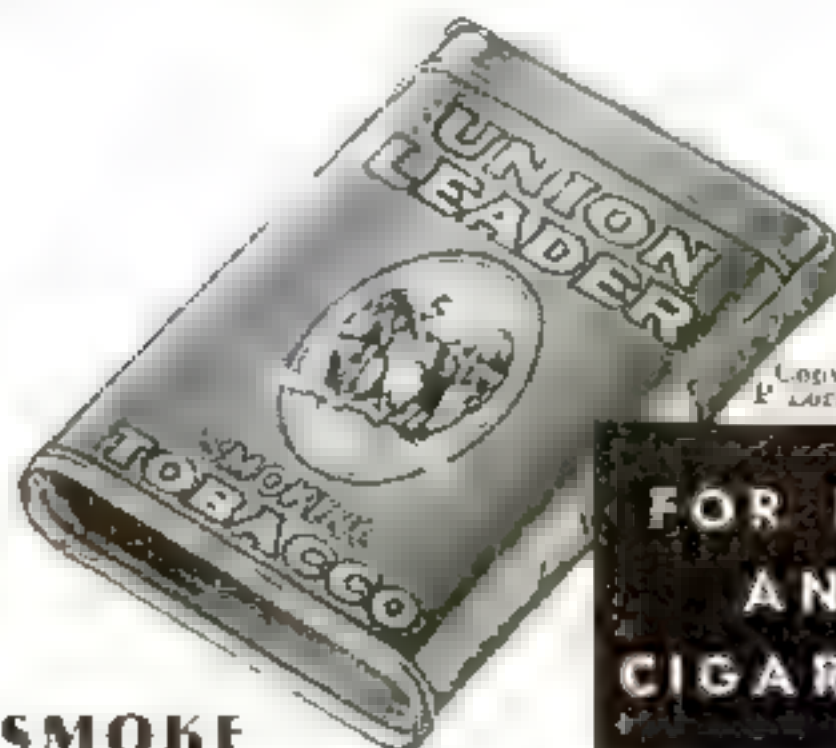
If a bad-acting pipe is "putting the heat" on your tongue, here's how to cool it, quick! Even reckless young pipes become law-abiding, when fed on Union Leader. It's the soothing effect of that fine, selected Kentucky

Burley—aged-in-wood to make a blissful blend of rich flavor and cool smoothness, with never a bit of bite! Apply at any tobacconist's for this old reliable pipe-pacifier—at the astonishing price of only a dime! (Rolls swell cigarettes, too.)

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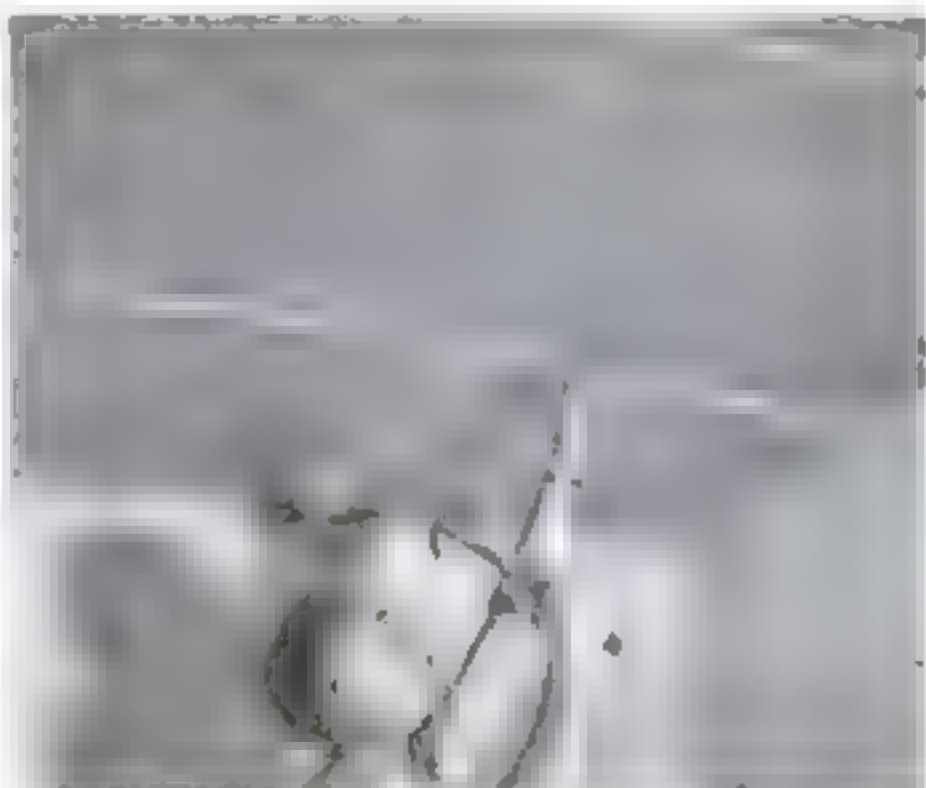
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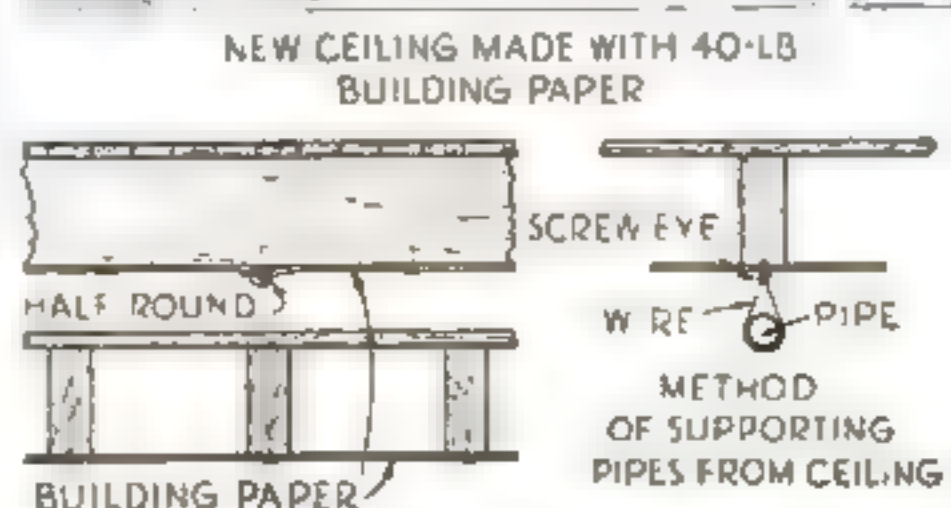
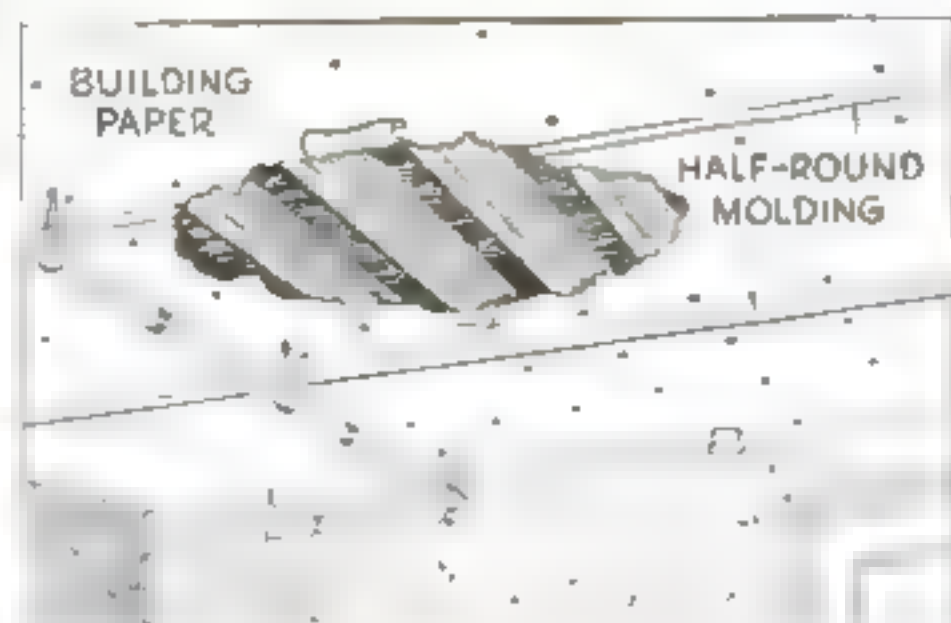
PAPER CEILING HIDES JOISTS IN CELLAR

HEAVY building paper, also known as sheathing or insulating paper, makes a practical and economical covering for a cellar ceiling. The best paper for this use is the type weighing forty pounds to the roll, which is about 1/16 in. thick, 3 ft. 6 in. wide, covers 500 sq. ft., and costs about \$1.60.

The paper is applied to the ceiling in the direction opposite to the way the joists run. Pull the paper tight across the joists and nail in place with large-head, long-shank, carpet tacks. There is no danger of the tack heads' cutting through and allowing a sag to develop because the paper is so tough, although large tin washers may be used beneath the tack heads if desired. Tack 1/2-in. half-round molding on to cover the overlapped joints of the paper.

It is easy to make a neat, tight job with this paper because it can be cut to fit around piping and similar obstacles. A method of hanging pipes from the ceiling is shown in the sketches, and wherever pipes may be suspended in this way, it will not be necessary to cut the paper.

A coating of shellac or varnish will prevent moisture absorption and makes a base for any finishing coat of paint desired. A ceiling of this paper, although not, of course, comparable to a high-grade wall board, costs very little, will last many years, and adds considerably to the neatness of the cellar. It gives a more finished appearance.—L. N. O.



How the heavy paper is stretched over the ceiling and the joints covered with molding

CLEANING LONG GLASS TUBES

WHEN cleaning long glass tubes with pipe cleaners, tie a string to each end and insert the string through the tube by means of a small weight. This enables you to pull the cleaner back and forth.—LEO GAUDETTE.

DEVELOP & PRINT YOUR OWN SNAPSHOTS

Save One Half!

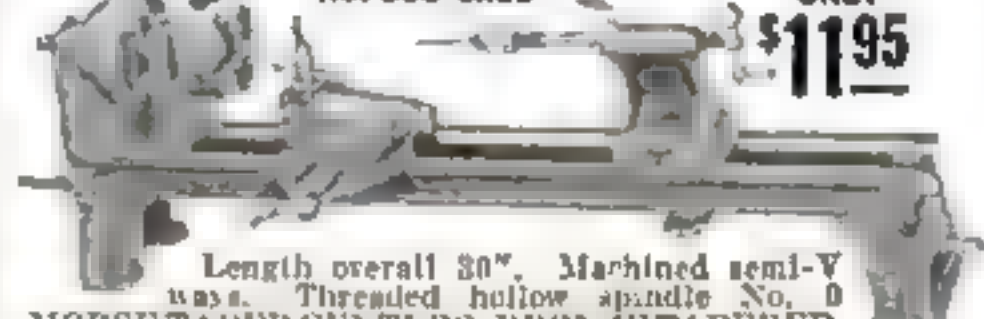
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METAL TURNING LATHE WITH LONGITUDINAL SCREW FEED No. 255-6x18" ONLY \$11.95



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NEW AUTO INVENTION Ends Oil Changing

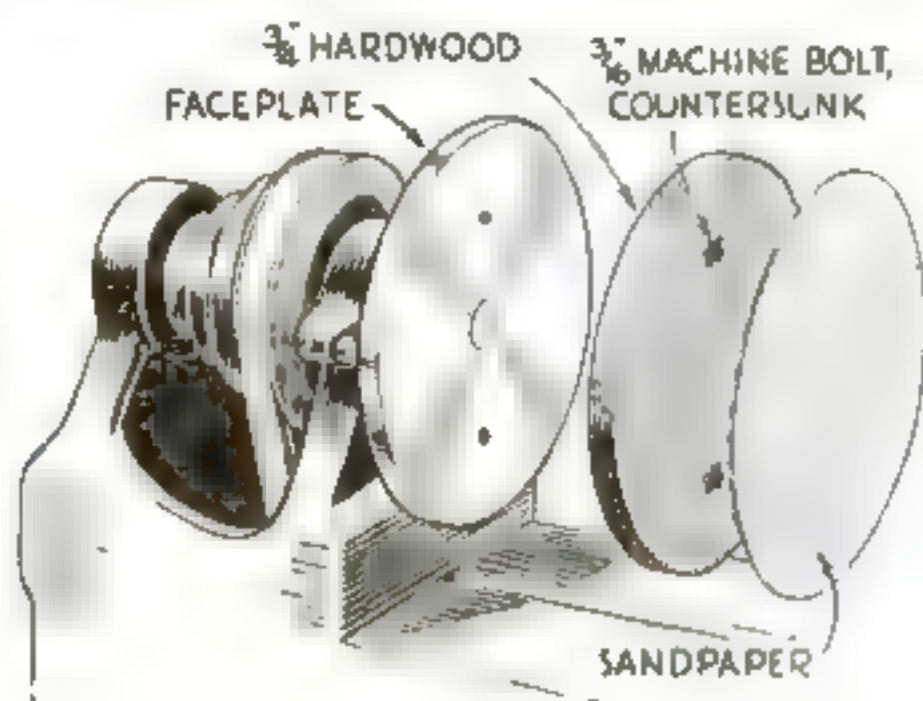
Sensation of Chicago Auto Show Now with the simple attachment of the new, amazing RE-CLAIM OIL REFINER to old or new motors, the expense of oil changing is ended forever! Replaces obsolete oil filters. Keeps oil clean and free from DIRT, WATER, DILUTION and ADD-ON. Be Oil-Wise—write at once for FREE startling oil facts. (Distributors Wanted) S. SCHWALBE CO., 2306 N. Western Ave., Chicago, Ill.

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INTERCHANGEABLE DISKS ARE AID IN SANDING

QUICK-CHANGING sanding disks are easily made as shown to provide coarse and fine grades of sandpaper at a moment's notice. Turn a $\frac{3}{4}$ -in. thick hardwood disk just large enough to take an ordinary sheet of sand-



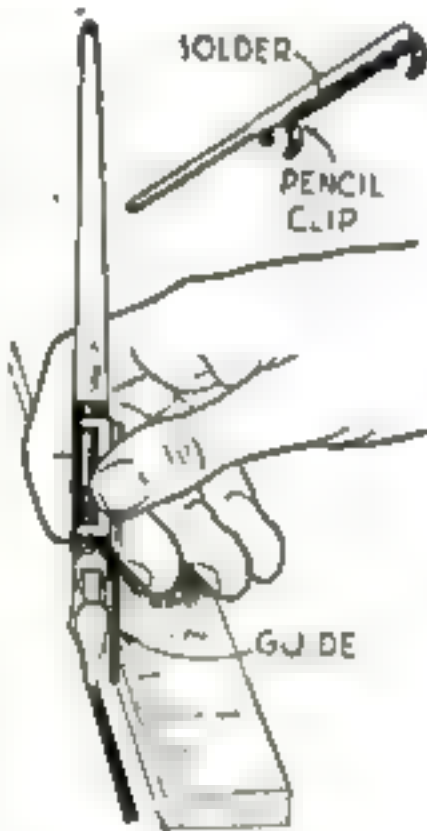
Each grade of sandpaper is cemented to a separate hardwood disk, which is fitted with two bolts for fastening it to the faceplate

paper. Bore two holes in the faceplate and corresponding holes in each disk. Cut square holes in the disk for countersinking the heads of the machine bolts flush with the surface. The bolts should be $\frac{3}{16}$ or $\frac{1}{4}$ in. and just long enough to extend through the faceplate for a nut.—B. O. MOODY.

CLIP GUIDES PEN POINT WHEN RULING LINES

IT IS often necessary to rule a large number of heavy lines with ink so that they are clear-cut and do not waver. If a special ball-pointed lettering pen is used in a regular penholder fitted with the attachment illustrated, a little practice will enable even an amateur draftsman to rule borders rapidly and smoothly.

Obtain a pocket clip of the type used on pencils. Remove the tab with the small ball at the end and, after cleaning the metal thoroughly, solder in its place a piece of $\frac{3}{32}$ -in. diameter brass. This rod should be about 3 in. long and project from one end of the clip $1\frac{1}{4}$ in. Round the projecting end to a half-ball shape. When inserting the pen in the holder, push it in until the rounded end of the rod and the tip of the pen project the same distance. With the rod resting against the edge of the rule, a clean line may be drawn without blotting.—J. H.

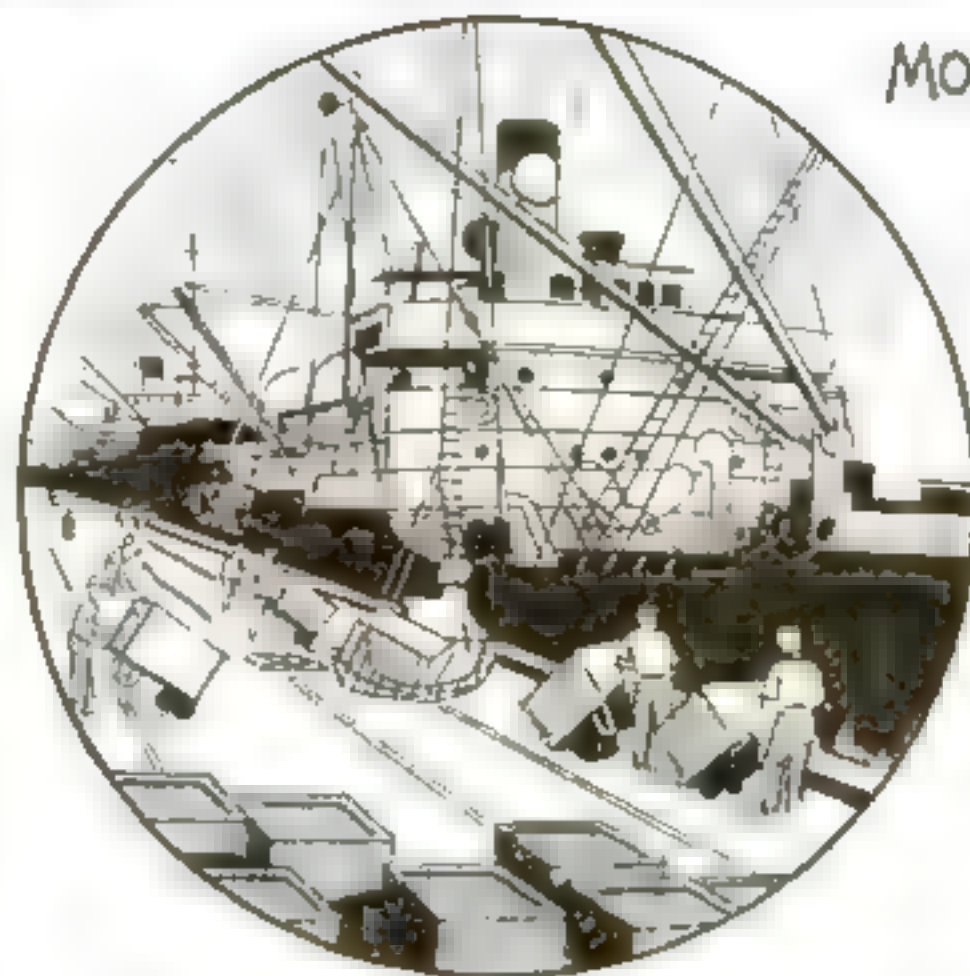


MAKING MAGAZINE RACKS THAT WON'T HOLD DUST

EVEN the humble magazine rack may be improved, much to the gratification of the neat housekeeper, by making the bottom of dowels, instead of the dust-catching solid bottom usually employed. Dowels of $\frac{1}{4}$ - or $\frac{5}{16}$ -in. stock may be used, spaced 1 or $1\frac{1}{2}$ in. apart.

If the side and center pieces of the rack are all to stand vertical, as in some designs, fasten them together temporarily with brads and drill them all at once, thus insuring that the holes will line up. If slanting sides are desired for the rack, block the pieces at the correct relative angle while drilling them. Cover the exposed ends of the dowels with strips of molding.—CLINTON F. BLAKE.

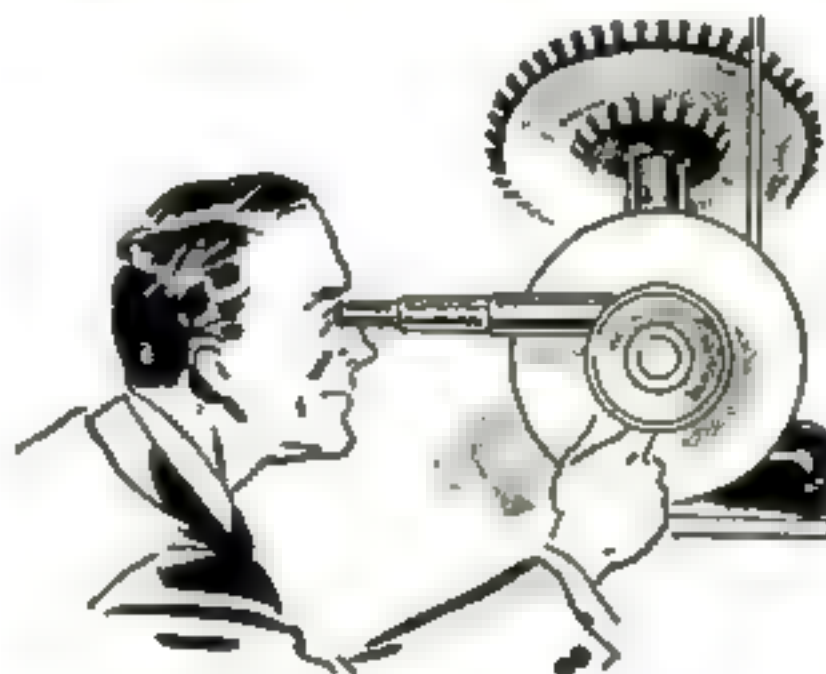
DID YOU KNOW— INTERESTING AND UNUSUAL FACTS ABOUT PAINT



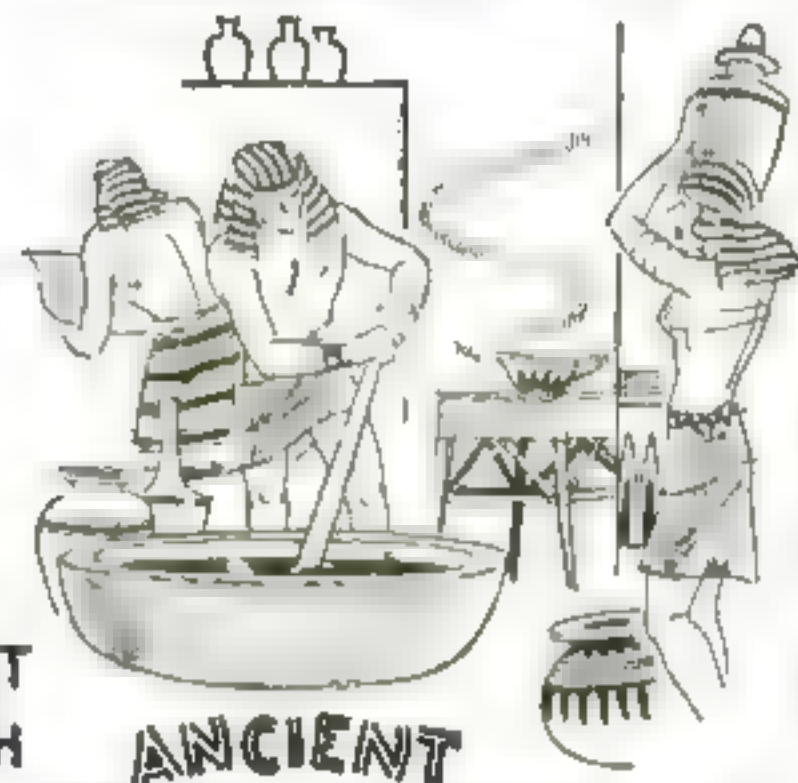
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GATHERED FROM ALL PARTS
OF THE WORLD ARE USED IN THE
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AND UNIFORMITY OF
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PRODUCED A MAGNIFICENT BLUE
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A SEMI-PRECIOUS MINERAL
OF GEM-LIKE PROPERTIES.**



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6" (1 1/4" hole), \$2.40 8" (1 1/4", 5/8", 3/4" hole), \$3.20
7" (1 1/4" hole), \$2.80 10" (5/8", 3/4" hole) . . \$4.05

De Luxe Hollow Ground Combination
6" (1 1/4" hole), \$3.90 8" (1 1/4", 5/8", 3/4" hole), \$4.90
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In Keystone Made-by-Disston Circular Saws, very little money buys a blade you can depend on for good work.

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Keystone Hollow Ground Combination
6" (1 1/4" hole), \$3.00 8" (1 1/4", 5/8", 3/4" hole), \$4.00
7" (1 1/4" hole), \$3.50 10" (5/8", 3/4" hole) . . \$5.00



Disston steel gives toughness that holds a keen edge...takes temper and tension that makes the saw seem alive. Disston taper grinding and Disston balance make a saw free running and sawing easy on hand and arm.

\$3.25 for Disston D-8, skew back, "The Saw Most Carpenters Use". \$2.90 for Disston D-7 straight back. \$3.60 for Disston D-23—Light-weight, straight back.



See also Keystone Made-by-Disston Hand Saw. Skew back and straight, Cross-cut and rip. Price, 95c, \$1.10, and up. K-3 "Pacemaker" skew back, full 26" blade . . . \$1.35

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How to Choose and Use Saws—answered in Disston "Saw, Tool and File Manual".



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SAYS:

WHEN a screw which should be a free fit in a nut enters both sides of a nut the same distance before grabbing, a lead error is indicated—not an oversize or tapered thread. A narrower nut is the remedy.

Check your micrometers for size with the spindle in three different positions, namely 0, 8, and 17 incident to longitudinal line on barrel. The reason is that the anvil and spindle end may be parallel at 0, but both may be out of square with the direction of traverse of the spindle.

The sides of metal-cutting saws converge toward the mounting hole. For that reason, it is necessary, when mounting on arbor, to use collars of equal diameters adjacent to such saws to avoid springing them saucer-wise.

When removing taper pins, file the small end of the pin flat and use a drive punch that is in good condition. The pin should move at the first impact to avoid "swelling" it in the hole and making removal impossible.

To prevent long cylindrical parts from warping when being hardened, place a thin piece of sheet metal on the surface of the quenching bath. The sheet metal should, of course, contain a hole large enough to accommodate the piece to be hardened when inserted endwise. The sheet metal keeps air bubbles from forming on the surface of the bath adjacent to the work.

In riveting countersunk-head rivets, heavy blows should be used to prevent surface hardening before the head is properly formed and the hole filled. If the nature of the work prohibits heavy hammer blows, use a greater number of rivets of a smaller diameter.

A ball bearing of the proper size, if pushed through an undersize hole, will burnish and size the hole.

In constructing jigs and holding devices for use in drilling work, always make proper provisions for burrs thrown up by the drill in order that the work can readily be removed from the device.

Keep a flathead screw of each size in your tool box for use as a countersink gauge for occasional jobs.

A suitable flux for use in soldering steel is made by pulverizing together one part of sal amoniac and ten parts of borax and fusing until clear. When solidified, pulverize to a powder.

For rapid turning of small diameters in the lathe, don't overlook the possibilities of hollow mills held in the tailstock.



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These wise old birds
Give sage advice.
They want to help
You lower the price
You pay for transportation.
Your car will show
New pep and dash;
Gas—oil—repairs
Will cost less cash
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**UNSIGHTLY
WALLS**
MADE GOOD AS NEW



You can easily repair holes in walls with Rutland Patching Plaster. Anyone can make a perfect job with Rutland.

NEWS OF GUILD CLUBS

(Continued from page 94)

tions in the following categories: Mr. Maxwell, drafting and designing; Mr. Wagner, model boats and overlaying; Mr. Brasholz, painting; W. Gast, whittling; Ludwig Fahrenwald, metal working; Peter Herbert, puppets; Earl Peek, Lester Wise, and Jack Zoller, jig-sawing.

Construction of a model railroad layout is HO gauge has been started by the Society of Model Engineers of *Ottawa, Ontario*. A. French is chairman of the project, assisted by G. B. O'Connor. Informal meetings are held at the members' workshops, where various problems are discussed.

J. L. Jacques is building a steam locomotive of the 1/2-in. scale Northern type, and R. Huard is at work on a 3/4-in. scale Hudson type. Both these engines should be running under their own power by the end of this month. Stationary engines have been completed by J. Stringer and W. J. Harding. Mr. French and A. P. Abolit have made models of engines and lawn ornaments. B. G. Birchall and W. Birchall have completed a coach that took two years to make. These two men also go in for model ships.

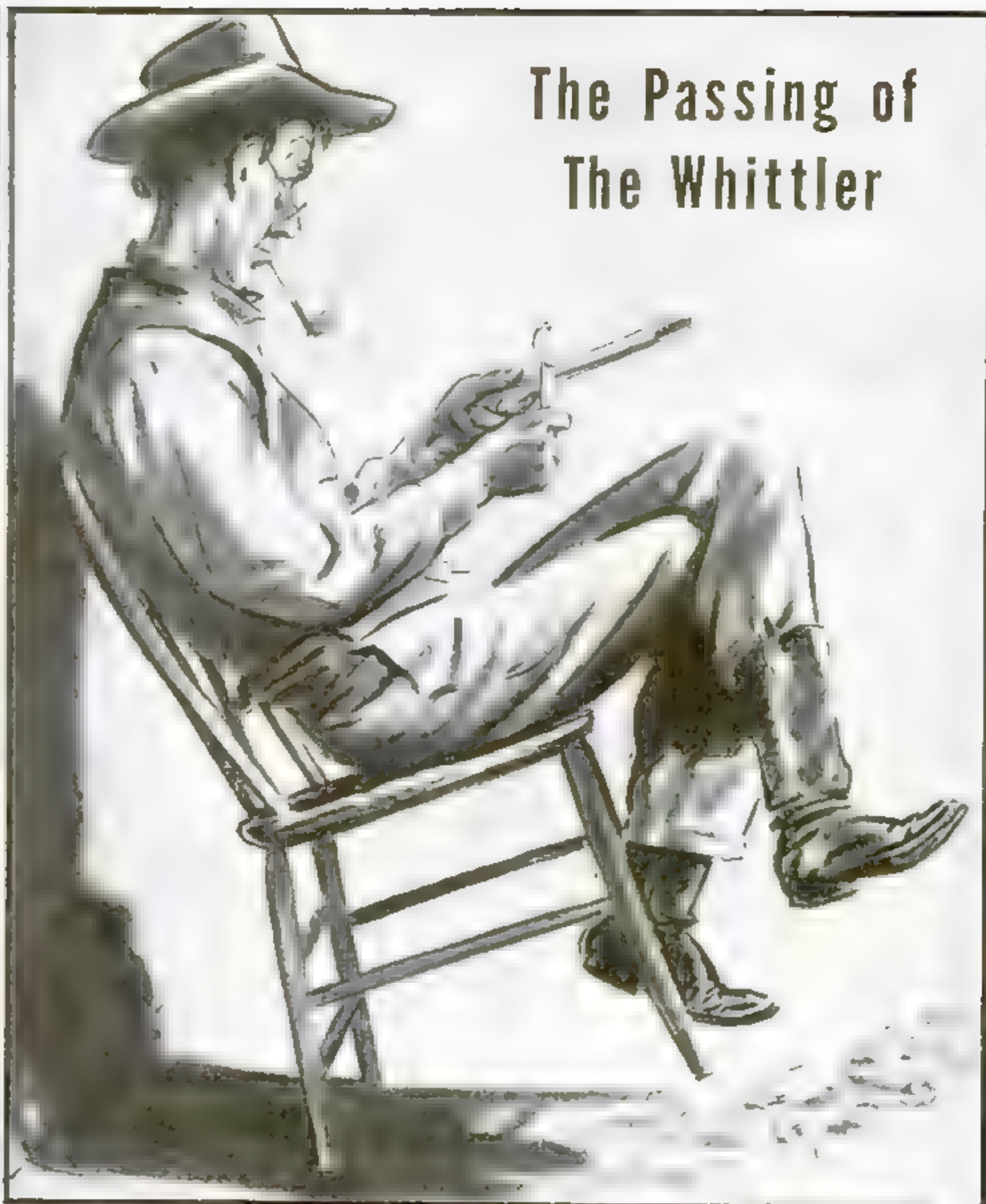
Interest in model railways seems to be on the increase in Canada so the Rev. D. H. McVicar, a member of the society, plans to start a club at *Buckingham*, his home town.

Inlaid pictures is the topic that the Program Service Bureau of the Guild has selected for clubs to study and discuss during April. A complete demonstration has been worked out showing how easy it is to make pictures and designs from wood veneers. The February program feature—a crossword puzzle composed largely of shop terms—appears elsewhere in this issue. The topic for March was house repairs.

The new officers of the Club des Artisans Amateurs, *Trois Rivières, P. Q., Canada*, come from all walks of life. The president, G. E. Richard, owns a dry-goods store; Dr. J. D. Paquin, vice president, is a dentist; Secretary-Treasurer J. Henri Dubé is a paper finisher. The directors are Jean Marie Bureau, lawyer; Emile Jean, newspaper manager; Jules Derome, assurance manager, and Salvatore O. Balleux, paper finisher. Through the courtesy of the city, the club now meets in a large hall, which is being equipped with tools and machinery.

Charles Bessette talked on finishing and Frank Murnane demonstrated joint cutting on the power saw at a recent meeting of the Spindle City Homestead Club, *Cohoes, N.Y.* . . . The Queen City Craftsman Club of *Cincinnati, Ohio*, has moved into new workshop headquarters furnished by the city's Recreation Commission . . . Officers of the Bison Homestead Club of *Buffalo, N.Y.*, for 1937 are Harold N. Salhoff, president; Herman W. Lorenz, secretary-treasurer; Fred Paul and Arthur Harding, board of governors. Toys were distributed to needy children at Christmas . . . The *Mansfield (Mo.)* Homestead Club purchases lumber in large quantities in order to obtain better prices for the members . . . The *Coulee Dam (Wash.)* Homestead Club has postponed its exhibition until later this spring . . . A dinner at the home of W. G. Sweeney marked the first anniversary of the *Fall River (Mass.)* Homestead Club.

The *Seattle (Wash.)* Homestead Club has acquired a complete woodworking and metal-working shop where members can work every evening . . . A large bird house was erected by the *Crookston (Minn.)* Homestead Club in a local park . . . Don Bennett, model airplane designer and builder, displayed his latest model at a recent meeting of the *Bartlesville (Okla.)* Homestead Club. The attendance prize of a matched dresser front was (Continued on page 110)



All over the United States, in well equipped shops in their homes, intelligent craftsmen are doing difficult jobs, showing rare skill with good tools.

What a difference from the time when men whittled aimlessly to pass the time away.

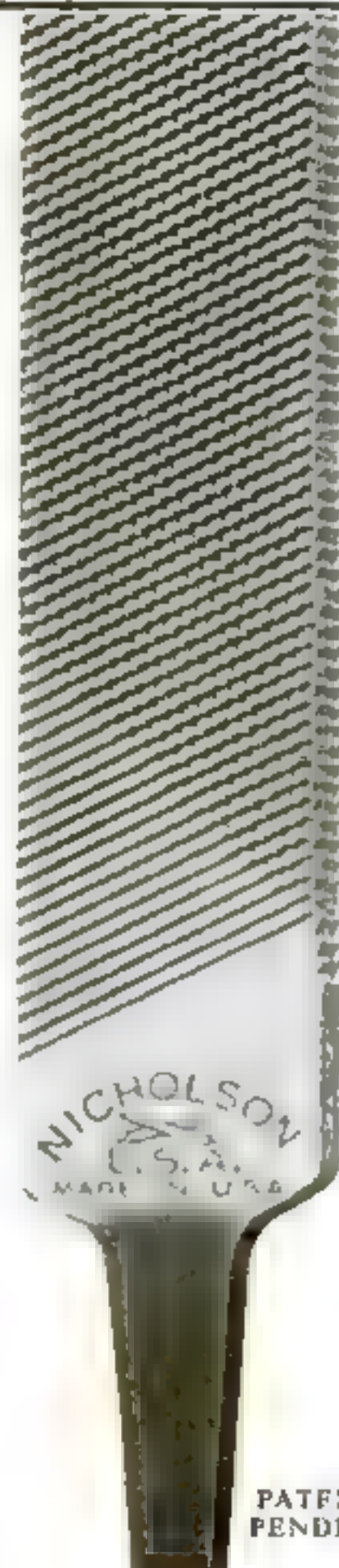
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Mill Bastard	6"	8"	10"
Slim Taper	5"	5 1/2"	6"
Extra Slim Taper	4 1/2"	5"	5 1/2"
Round Bastard	6"	8"	10"
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are an indispensable part of your home equipment. Let your hardware store or supply dealer take care of your needs. Nicholson File Company, Providence, R. I., U. S. A.

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NEWS OF GUILD CLUBS

(Continued from page 109)

won by George Murphy . . . New officers of the Homeworkshop Club of **Mason City, Iowa**, are John R. Conaway, president; Max Minott, vice president; Leon C. Thomas, treasurer, and Max Boyd, secretary . . . A canoe within a cage whittled out of one piece of soft pine by Ted Jendrzczak won first prize in the "Whittling Night" program of the **Buffalo (N. Y.)** Homeworkshop Club. Chester Dyl demonstrated wood finishing at another meeting.

W. W. Cranford, first president of the **LaGrange (Ill.)** Homeworkshop Club, who has moved to Detroit, was presented with a toolmaker's square and a gimlet, and Roger Wilson, outgoing president, with an oilstone and pair of pliers at the club's third anniversary. Dr. R. T. Mathews is the new president.

By charging a small fee, the **Fargo (N. D.)** Homecraft Guild has built up a large library



Window display of some of the projects auctioned off by the club in Jacksonville, Fla.

of home workshop books, which members may borrow. The club's main project last year was the installation of a shop for boys at the North Dakota Children's Home, Fargo. Officers for this year are O. M. Mickelson, president; Art Malme, vice president; John C. Pollock, secretary-treasurer; Gunnar Heland, librarian; Chris Sorenson, O. M. Elde, and D. O. Hazeldahl, governors.

The Sunset Social and Hobby Club of **Brooklyn, N. Y.**, began the year with a large party. James Arnish is making a metal bench to hold a lathe the club is obtaining. Ivan Finnberg is building photographic equipment. Robert Hasselo is designing his own gas model airplane.

New officers of the **Brunswick (Me.)** Homeworkshop Club are J. G. Russell, president; S. N. Francis, vice president; W. A. Duquette, secretary-treasurer. On the board of governors are Ralph Derby, Benjamin Burbank, Earle Small, Chilton Smith, and the officers . . . L. C. Montgomery, manual training and mechanical drawing instructor at the new Abbot School, took the Home Crafters Club of **Elgin, Ill.**, on an inspection tour recently. Moving pictures on book binding and termites were shown. Julian R. Gromer and Werner M. Lienert are constructing model power boats, which they hope to enter in a national competition . . . Through the cooperation of the machine-shop teacher at Eastside High School, the Columbus Homeworkshop Club of **Paterson, N. J.**, has made its own saw tables and bench grinders . . . Sixty wooden monkeys were made by the **Racine (Wisc.)** Homeworkshop Club and turned over to the Boy Scouts for distribution to poor children . . . Bernard McKain demonstrated woodworking on the lathe at the **Portland (Ore.)** Homeworkshop Club recently. The local electric company has offered the use of its windows for the club's exhibition . . . (Continued on page 111)

UNCRAKABLE CEILINGS of lasting charm

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Cleanly and easily applied right over cracked plaster

Look up at your ceilings! If they're cracked and unsightly, Upsonize!

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THE DEPENDABLE BOARD WITH
THE FAMOUS BLUE-CENTER

NEW BOICE-CRANE "Tilt-Arbor" SAW

10" Blade

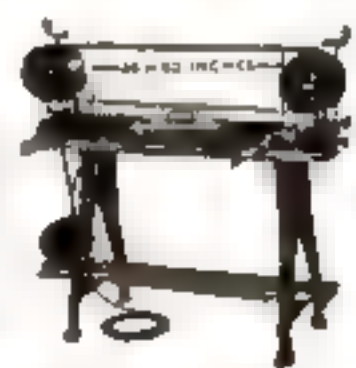


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NEWS OF GUILD CLUBS

(Continued from page 110)

Because of increased interest, the North Shore Craftsman Club of *Waukegan, Ill.*, is holding two meetings a week in the club workshop, which is equipped with tools, machines, and two workbenches. New officers are C. W. Clark, president; Charles Crapo, first vice president; A. E. Zell, second vice president; William Graf, secretary; Charles Stone, treasurer.

A field day, an exhibition, and demonstrations are among the events scheduled for this spring by the *Dover (N. H.)* Homecraft Club. Work on Christmas toys will be extended over the entire year. All the officers were reelected for 1937 . . . The largest club in the Guild is the Homecraft Club of *Pittsburgh, Pa.*, with 343 members . . . Officers of the Capital Homecraft Club of *Washington, D. C.*, are Edgar W. Parks, president; William Howard Galbraith, treasurer; Ellsworth D. Jones, secretary . . . At the annual meeting of the *Peekskill (N. Y.)* Homeworkshop Club the following were elected: Henry Keller, president; Herman MacPeck, vice president; Lester D. Jessup, secretary; George C. Court, treasurer; Donald Kilmer, librarian; Edward Kurzhals, Thomas Monteleone, and Dr. Edson R. Brewer, board of governors. The annual exhibition opens March 19.

Edward Gosselin has been elected president of the *Ware (Mass.)* Homeworkshop Club; D. C. Milhgan, secretary-treasurer; Rudolph Bouvier, librarian. Mr. Gosselin exhibited models of the U. S. battleship *Texas* and Farragut's flagship *Hartford*, which he had made from *POPULAR SCIENCE MONTHLY* plans. . . An exhibition was held recently by the *Winfield (Kan.)* Homeworkshop Club in a hardware store window.

WRITE FOR INFORMATION ON ORGANIZING A CLUB

THERE will never be a better time than now to start a home workshop club in your neighborhood, so that you, too, can participate in the many free benefits of the National Homeworkshop Guild. Until you have actually experienced it, you cannot fully realize the many advantages that result from meeting regularly with others who enjoy the same hobby. Don't delay in sending for the Guild's special bulletin (No. 16), which tells how you can join this great movement.

As a special inducement, the Guild will supply each club joining during March and April with copies of the monthly bulletins for the past few months, which contain the results of a survey recently made by the Program Service Bureau. This survey lists a wealth of ideas for conducting interesting and instructive meetings. A stamped and self-addressed envelope inclosed with your request will immediately bring you full particulars about the free membership plan and an application blank.

National Homeworkshop Guild
347 Fourth Avenue, New York

Please send immediately full particulars on how I can start a home workshop club in my neighborhood and make it a successful organization. Be sure to include a copy of a model constitution and an application blank for a free charter in the National Homeworkshop Guild. A large (legal size), self-addressed, and stamped envelope is inclosed for your use in sending me this material.

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OUR NEW BRIG MODEL

(Continued from page 93)

wide to the stem, lay it along the hull as close to the deck line as possible but without any forcing up or down, and fasten it with clamps or thumb tacks. Set the dividers firmly to the greatest distance between the cardboard and deck line and prick a mark at each frame showing this distance. Remove the cardboard, draw an even curve through the marks, and cut it to this line; then, when it is laid on the model, its curved edge should lie along the deck line. Make adjustments if necessary and scribe this line on the wood for the planks. (The lower edge of the first three planks will be but slightly tapered to the ends).

Cut a top plank for each side and nail in position. I use a little glue at the ends to assist the nails.

The second plank is laid out the same way by marking on the cardboard spiling staff from the lower edge of the first plank.

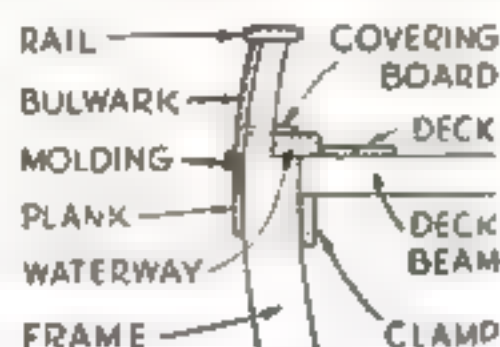


Diagram showing the bulwark construction

After the first three planks have been applied, the bulwarks should be fitted, to guard the timberheads. I made each bulwark in one piece, but it can be of several planks. The template for the lower edge of this piece will be cut to the same line as the upper edges of the top strakes. For the upper edge of the bulwark, I laid this cardboard along the timberheads and on it, from the sheer plan, marked the vertical height of each frame, then drew a smooth curve through these marks and used that as a template. The bulwarks might be cut oversize and shaved down when fixed in position. Note that each is considerably wider at the bow than the vertical height. (See the body plan published last month.)

The front end is set into the stem rabbet, but the upper half is cut across level with the knightheads. The ends of all planks are temporarily allowed to extend beyond the stern.

THE upper counter, or taffrail, is a 1/16-in. thick board (really several planks). Its lower edge is the line of the deck. The sides meet and overlap the bulwarks, and the top has slightly more crown than the deck. For the athwart curve, it is necessary to steam the wood. For the knees supporting this, I slotted four 1/8-in. pieces into the waterways. Similar pieces are used at the corners, but rounded outside to the shape of the bulwarks.

On top of the bulwarks there lie the main, or cap, rails, 3/32 by 1/4 in. I cut these to shape as far back as frame H and bent the rest into shape with a scarf joint. Some woods will need steaming; others will bend sufficiently. The rails are nailed to the timberheads with 1/16 in. outside the bulwarks. The taffrail piece should be cut to shape.

The waterways are 5/32 by 1/4 in. wide. They lie on the frame ends and deck beams, close up to the timberheads. They will have to be cut to shape at the bow and steamed the rest of the way. The piece across the stern is wider, cut horizontally to the curve of the stern and vertically, inside and out, to the line of the taffrail, with rabbets for the taffrail stanchions.

If neatly made, your framework is now quite stiff and strong. Remove it from the building plank and lay a flexible batten along the frame edges at frequent intervals to see if it rests neatly on them to give smooth curves; if not, file them down until you have smooth contours (Continued on page 113)

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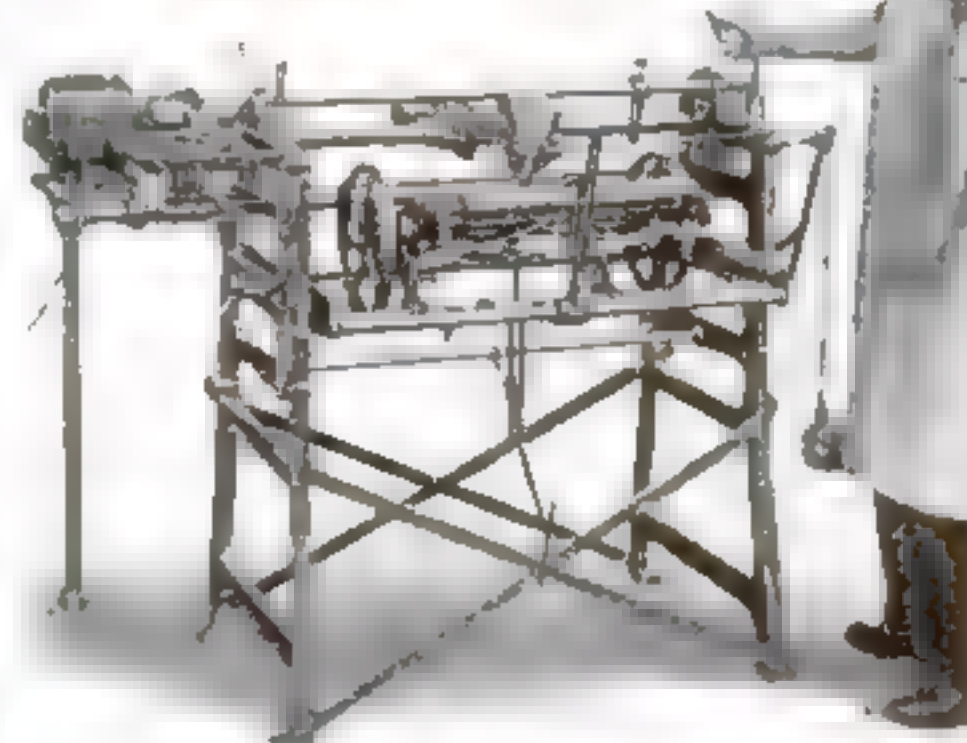


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OUR NEW BRIG MODEL

(Continued from page 112)

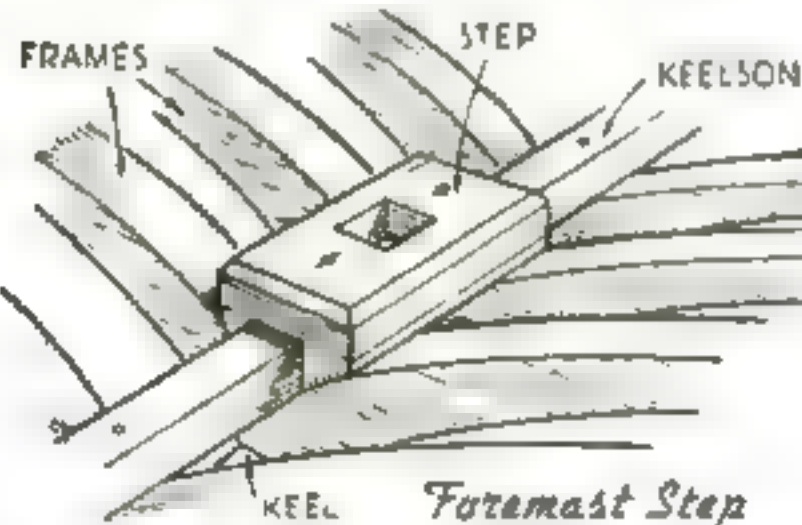
along which the planks are to be nailed. The planks for a vessel of this size would be about 8 in. wide by 3 or 4 in. thick. I used fourteen planks to a side, each $\frac{1}{4}$ in. wide at the x-line, where the beam is greatest. With a level-keel vessel, one would use the 5-4-3 rule for tapering to the ends; that is, a proportion of 5 amidships, 4 at the stern, and 3 at the bow, but as our craft has a heavy drag, this rule will not work.

Since the three top planks are on, the garboard (bottom) strake comes next. This fits into the rabbet in the keel, stem, and sternpost. In order that the main body of the planks may flare upwards at the ends, the garboard and next two strakes are wider at the ends than amidships. They will each be about $\frac{1}{2}$ in. wide at the stern, but owing to the drag they will not widen at the bow.

These three planks being on, measure the exact distance from the top of strake three to the lower edge of the upper wales on frame x. Divide this into eight parts. Now make a diagonal scale as shown and lay down on it the distances on frames 5 and 28, with perhaps a couple more in between. This scale makes it a simple matter, once the lower edges of each plank have been marked with a spile as described, to lay out the widths of the planks at the several stations suggested. Note that under the counter the planks widen out again to fill the space.

The thickness of the planks should vary with their position, but may well be made a uniform $\frac{1}{16}$ in. thick, perhaps shaved down slightly at the ends to help them take the curves. (I shaped my planks from $\frac{1}{8}$ in. wood, which I then slit down the middle with a very fine circular saw, thus giving me a plank for each side.)

To fasten the planks, I used glue and nails at the ends and one nail into each frame. There are to be had very fine $\frac{1}{4}$ - and $\frac{3}{8}$ -in. nails, but $\frac{1}{2}$ -in. bank pins will do. Start



To support each mast, a substantial block or step is nailed and glued to the keelson

them in, snip them nearly half off, then tap them home. This will form a burr sufficient for a head.

In the wake of the rigging, between the second and third wales and the beam clamp, some filling pieces should be glued, to which the chain plates can be bolted.

There is a $\frac{1}{16}$ -in. molding outside, below the deck level, from the trail boards and around the stern.

It should be mentioned again that on my model I planked one side completely, but on the other put only the three top planks with the garboard and second broad plank below, thus leaving the interior construction visible. The planked side I painted black to the water line and copper color below, with a red molding; on the other side I painted the bulwark and molding and varnished the natural wood below.

At the bow triangular cheek knees must be whittled to support the beakhead. They fit the angle of stem and bow planks. Their top follows the lines of the stem, and the lower face is parallel to the upper.

(To Be Continued)

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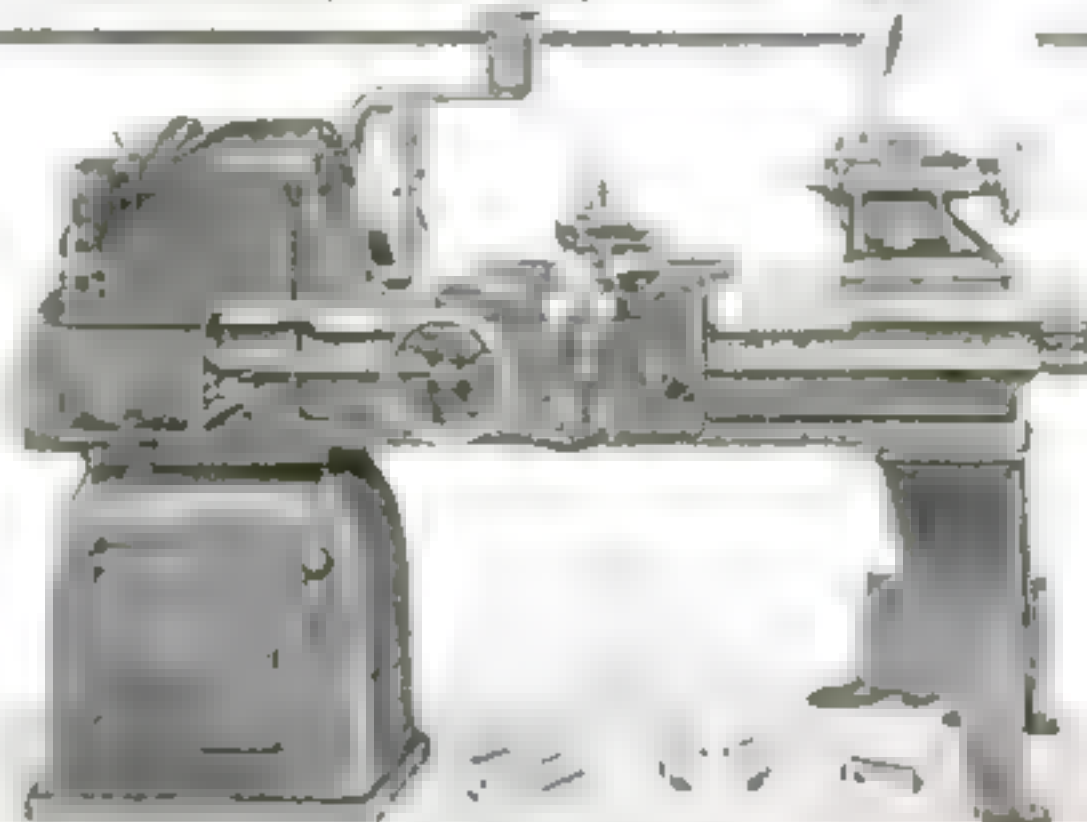
Features include Twin Gear Reverse to lead screw. Ball Thrust Bearing on Spindle. Longitudinal Screw Feed to Carriage. Precision Lead Screw for Cutting screw threads—and scores of other important features. Takes 38 practical attachments for milling, grinding, draw-in collet chuck work, and many other manufacturing jobs.

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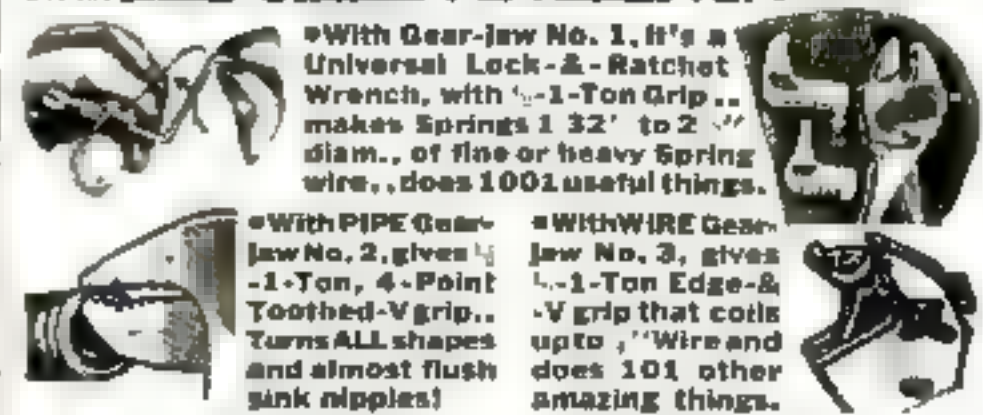
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**HINTS ON PAINTING
EXTERIOR TRIM**

(Continued from page 88)

painters burn off the old paint. There is no use in putting strong new paint over faulty work as it only increases the peeling and checking. I suggested that he use a lead-and-oil paint formula reinforced with from fifteen to twenty percent zinc oxide for hardening the white lead and from ten to fifteen percent titanium oxide to increase the hiding power or opacity.

"WHAT you must do," I emphasized, "is to buy quality paint from a reputable local dealer who in turn buys only from a manufacturer with a national reputation." Here, in brief, are some of the essentials of outside painting, whether you do the work yourself or hire others:

Carefully wash all paint surfaces free of grime and wipe them dry. If you are, for example, going to paint the trim of a shingled house such as that shown in the accompanying illustrations, it might be well to wash all the window jambs and casings on one side before starting to paint in order to allow time for proper drying.

It is generally advisable to give two coats of paint. When the first coat has dried, the putty work should be done. All loose nails in the siding or elsewhere should be set about 1/8 in. deep before any painting is started. After the first coat, apply a putty made of two parts good quality whiting and one part dry white lead. Mix well, moisten very slightly with linseed oil, and work on a sheet of tin or glass until the mass begins to coalesce. Finally knead in the hand until fairly soft, but not sticky.

A SMALL roll of putty is kept in the palm of the left hand, a wad is held beneath the thumb and forced into the nail hole, then the putty knife, held in the right hand, is slipped under the thumb against the wood. A slight smoothing off with a cross stroke of the heel of the right hand closes the edge of the putty and seals the opening. Let all putty dry two or three days before applying the last coat, or the paint will dry without gloss over the putty, leaving noticeable spots.

In thinning a good quality paint for the first coat, use only pure gum spirits of turpentine, not turpentine substitutes, or the paint will not stick as it should. Paint should be brushed vigorously to a thin film, not excessively reduced with turpentine simply to make the work easier. The labels of many paint manufacturers suggest the addition of a quart of boiled linseed oil to a gallon of prepared paint, but be sure your dealer gives you pure boiled linseed oil and not a compound made from rosin and oil or similar substitutes, which will spoil the best paint made.

For pointing up sash, use a 1-in. black China brush or a long-handled 2-in. single-thick sash tool; for jambs and casings a 6/0 oval or 3-in. XXX black China brush. Handle the upper and lower sash to expose the inside faces of the lock rail, which must be painted. It is best, if possible, to do both inside and outside faces of sash simultaneously. After the sash have been painted, the jambs must be coated. Finally the casings are trimmed, starting with the head casing. Leave the windows up about 1/4 in. above the top of the inside window stool to prevent marking or sticking; then paint the outside sill. After the paint has dried, work the sash up and down a few times and rub the inside edges of the thumb stop with a cake of paraffin to prevent future sticking. Do not use soap.

The observance of these precautions will prevent difficulties such as my neighbor experienced. Good materials and careful work are what produce a durable job.

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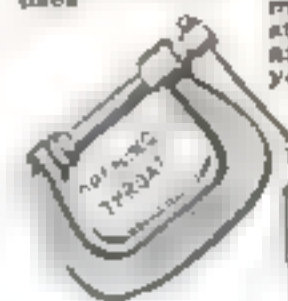
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Leaf Designs Decorate Easter Eggs



Small, wet leaves are wrapped around the eggs and tied, and the eggs then dyed brown by boiling them in water with onion skins

IF YOU want something different in the way of Easter-egg decorations this year, try this novel variation of the old trick used in the days before egg dyes were common, when the eggs were sometimes boiled with onion skins to give them a distinctive brown color.

Obtain some small leaves from house plants, weeds, blades of grass, or anything that happens to be available. Wash them, wrap them while wet around the eggs, and fasten them with fine cotton or silk thread. Boil the eggs in plain water along with a handful of onion skins. When the wrappings are removed after the eggs have been boiled, each egg will bear the decorative white imprints of the leaves on a rich brown-colored background. The thread must be very fine or lines may show.—A. G. HOFAMANN.



CAMERA TRIPOD BRACE ALSO ACTS AS SHELF

MADE in a few minutes with the simplest tools, the tripod brace shown above is easy to attach, and when in use serves also as a handy shelf for accessories. To make the brace, a triangle 6 in. on each side is cut from a thin board or piece of plywood, and the corners are rounded off with a radius of about $\frac{3}{4}$ in. Attached as illustrated, it keeps the tripod legs spread apart, while a heavy rubber band just below it prevents them from spreading any further. Another advantage of a brace of this type is the ease with which the spread of the tripod feet may be adjusted by moving the brace up or down.—GUY A. RAFUSE.

PREPARING METAL TO TAKE A PENCILLED LAYOUT

CUTTING outlines may often be drawn in pencil on metal instead of being scribed with a pointed tool if the surface is first coated with a mixture of yellow ochre in powdered form and shellac thinned with an equal quantity of alcohol. The mixture dries in a few minutes and can be removed, once it has served its purpose, with a cloth dampened with alcohol. Keep the preparation tightly covered.—W. T. BAXTER.



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<p>SURE WISH I KNEW WHY MARY TURNED DOWN MY BID FOR THE PROM</p>	<p>GET RID OF THOSE HICKIES IF YOU WANT TO CUT ANY ICE WITH MARY</p>	<p>THEN BUD GETS A TIP</p>	<p>SAY, MARY, THERE ANYTHING I CAN DO ABOUT THESE?</p>	<p>FLAUSCHMANN'S YEAST IS FINE TO CLEAR UP PIMPLES</p>	
<p>NEXT DAY HERE BUD MOTHER SAYS YOU'RE TO EAT 3 OF THESE EVERY DAY</p>	<p>SAY, HEAR THIS YOU GET A BOOK OF DANCE LESSONS FROM ARTHUR MURRAY IF YOU FILL IN THIS FLAUSCHMANN DANCE CARD</p>	<p>4 WEEKS LATER BUD SENDS FILLED IN DANCE CARD FOR BOOK</p>	<p>WHO IS THAT GOOD LOOKING BOY? HE'S A MARVELOUS DANCER</p>	<p>THAT'S MY KID HOT LIPS! BUT MARY BAD IS HE?</p>	<p>IT'S WONDERFUL HOW YEAST HELPED HIS FACE</p>

**ASK YOUR GROCER FOR THIS FREE
FLAUSCHMANN DANCE CARD**

Remember — this special ARTHUR MURRAY Dance Book is not for sale!

The ONLY WAY to get it is with Fleischmann's Yeast Labels! Paste these on the Fleischmann Dance Card your grocer will give you. Send it in!

If your grocer has no Dance Cards, you can get the book by pasting the 81 labels on a sheet

of paper, or putting them in an envelope, and mailing with your name and address to Fleischmann's Yeast, 701 Washington St., New York City. (This offer holds good until August 31, 1937.)

(Details of securing Dance Book differ slightly in states West of Denver and in Canada, see newspapers or ask your local grocer.)



"Stick to it—and Fleischmann's Yeast will help to clear up Adolescent Pimples," says Dr. R. E. Lee, well-known physician

● Pimples often come after the start of adolescence—from about 13 to 25. Important glands develop at this time, and final growth takes place. The entire body is disturbed. The skin gets oversensitive. Waste poisons in the blood irritate this sensitive skin—pimples break through! Fleischmann's Yeast helps correct pimples by clearing these skin irritants out of the blood. Eat 3 cakes every day, a cake about $\frac{1}{2}$ hour before meals—plain, or in a little water. Start now.

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MODEL HEADLIGHTS GIVE WELL-FOCUSED BEAM

THE builder of model railways may find many uses for the so-called "fountain pen" type of flash-light bulb, rated at 2.5 volts. The bulb is only 1/4 in. in diameter and about the same in length. A miniature lens, which is a part of the bulb, gives a focused ray, making the lamp especially adaptable for locomotive head lamps and signal lamps.

In adapting one of these bulbs to a model interurban trolley, I put the bulb through from the back of the dash so that the glass projected into the headlight, which it just fills, leaving only the tiny lens showing from the front outside. This gives a realistic appearance, whether lit or not; and when lit, it projects a ray of light down the track, instead of diffusing it over the landscape in the usual unreal manner. Flash-light cells in the car are used to supply current for the light, thus doing away with variations in illumination due to power changes such as must be expected when a lamp is connected to the main power supply.—ARTHUR L. D. FORD.

BUILDING CLOCK CASE TO SUIT MOVEMENT

BEFORE building a clock case of any type, it is advisable to obtain the dial and movement, or at least to find out the exact dimensions of the dial and movement you expect to purchase. The reason is that many of the modern movements—and you will certainly want a modern movement in the clock—cannot readily be adapted to clock cases of the older variety. If, however, you get the movement and dial first, you can either modify the proposed clock case to suit or else select another design. Some craftsmen, who have overlooked this precaution, have discovered upon completing an elaborate case, perhaps copied from a museum piece, that it was impossible to get a ready-made dial or a suitable movement.

LISTS OF MATERIALS FOR NEW PROJECTS

PORTABLE FIREPLACE (Described on page 82)

No.	Pc.	Description	T.	W.	L.
1		Hinged top or lid	3/4	11 1/4	68
1		Strip for hinging lid	3/4	2	68
2		Sides	3/4	11 1/2	48
2		Front uprights	3/4	11 1/2	36 1/2
1		Front crosspiece	3/4	11 1/2	66
1		Shelf	3/4	11 1/2	64 1/2
1		Imitation marble	1/2	11	48
2		Imitation marble	1/2	10 1/2	27 1/2
1		Top molding	See detail A		96
1		Lower molding	See detail B		96
1		Galvanized iron	26 ga.	36	48
1		Angle iron	1	1	96
1		Linoleum for base		36	72

TEA WAGON AND CABINET (Described on page 83)

No.	Pc.	Description	T.	W.	L.
2		Sides	3/4	27 1/4	28
1		Top	3/4	15	28 1/2
2		Sides of frame	3/4	1 1/2	27 1/2
2		Ends of frame	3/4	2	9 1/2
2		Bottom braces	3/4	3	12 1/2
1		Drawer front	3/4	3 1/2	12 1/2
2		Drawer sides	1/2	3 1/2	27 1/2
1		Drawer back	1/2	3	12
1		Drawer bottom	1/4	12	27 3/4
1		Tea-wagon front	3/4	14	23
1		Tea-wagon top	3/4	12 1/4	26 3/8
2		Tea-wagon shelves	1/2	12 1/4	26 3/8
2		Tea-wagon legs	3/4	2	20 1/2
2		Handles	1	round	8
4		Handle supports	1	1 1/8	1 1/8
1		Line inlay		3/4	14
1		Line inlay		1/2	14
2		Rubber-tired wheels, 3-in. diameter			

NOTE: All dimensions are given in inches.

THOUSANDS AMAZED HOW NEW 3-WAY TREATMENT INCREASES WEIGHT

1 Rich, red blood necessary to properly nourish and build up every part of the body, is especially promoted by this new discovery where it is needed.

2 A healthy digestion which gets ALL the good out of the food you eat, requires an adequate supply of Vitamin B. This new discovery supplies this element.

3 Normal, regular elimination to remove poisons and thereby promote health and growth, requires adequate Vitamin B. This is the third purpose.

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UNNECESSARY
FOR THOUSANDS
TO BE
SKINNY



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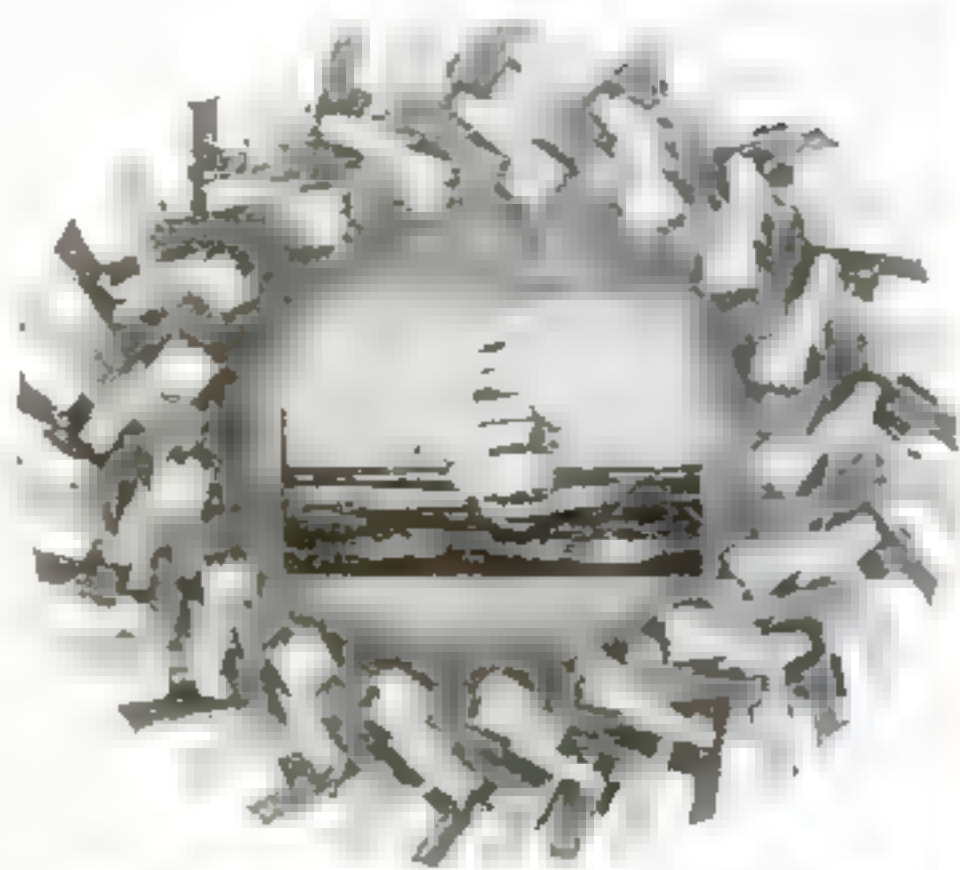
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Posed by
professional
models



Interlocking slips of wood form the border

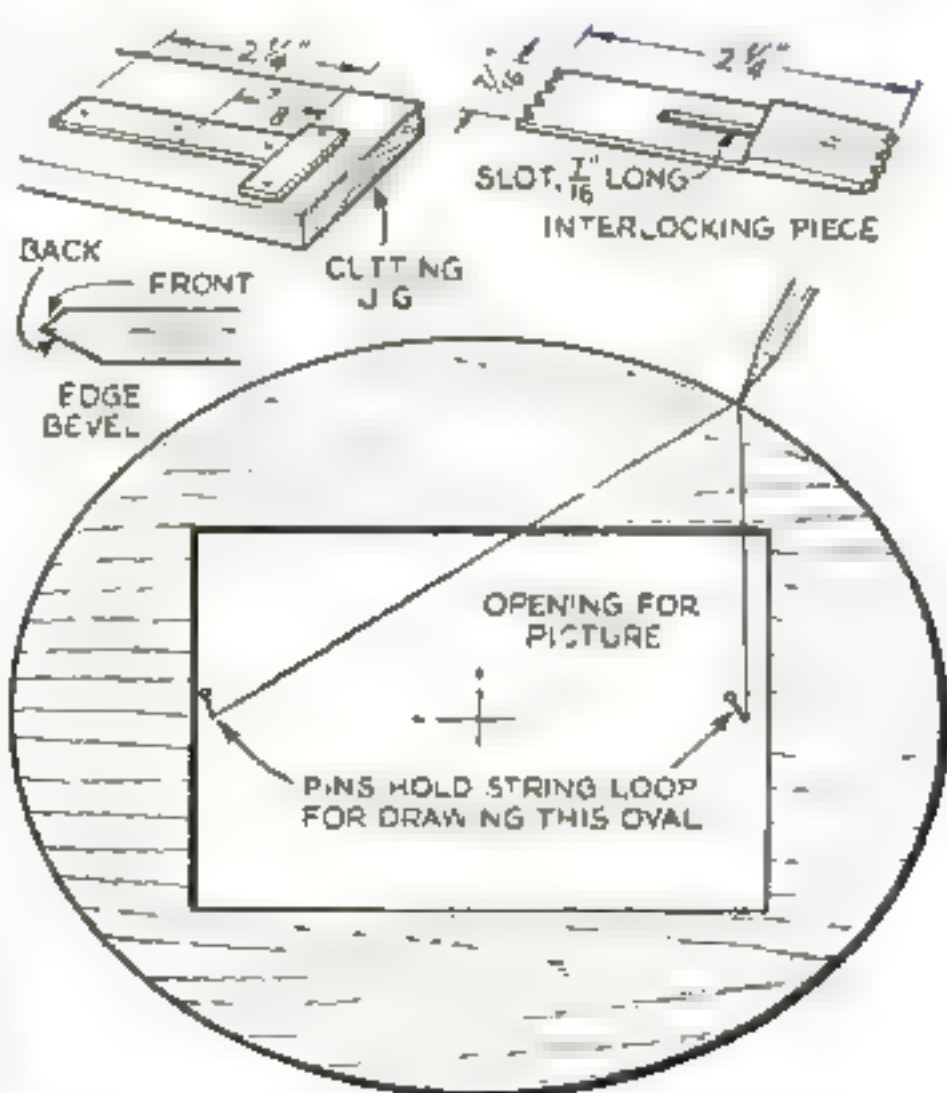
MAKING PICTURE FRAME BY SEAMAN'S METHOD

"WHAT sort of craftwork did old-time sailors do during their spare time on long voyages?" is a question I have been asked many times. Some of them made ship models, of course, but they had other pastimes. One of their curious and entertaining stunts was to make picture frames of the type illustrated above. You may like to try it, because the whole thing can be made with a pocketknife from scraps of wood.

For the interlocking pieces, cigar-box wood is suitable. The frame looks better if brown and white pieces are alternated, so try to find some cigar boxes that are of white wood covered with paper veneer, as well as the ordinary cedar type. Choose only pieces of the same thickness—usually the tops and sides.

Cut the wood in strips, all of the same width—about $\frac{7}{16}$ in. Then make a gauge or jig from scraps of wood as shown. Place one of the strips in the angle of the jig, saw it off to the right length, and make a saw cut halfway through at the $\frac{3}{8}$ -in. mark. Whittle half the thickness of the piece away from one end to this mark and, if you like, taper the heavy end. Then, with the knife point or a tiny chisel (ask your dentist for an old one), make the end cuts of the slot and cut the entire slot out with the knife. Cut notches in the ends or decorate the piece in any other way you prefer—with carving or even painting, if you wish.

A number of similar pieces are needed. For the frame shown, $7\frac{1}{2}$ by $8\frac{1}{2}$ in. over all, 96 were used. To assemble, just slip one piece through the slot of the previous one. After the first four, the back of each piece slides along the edge of the last but one, always with the slot ends (Continued on page 118)



One of the interlocking pieces, the cutting jig, and the method of laying out an ellipse

New York to Los Angeles...and BUST!



**Battery Goes Dead in Desert!
But Long Island Boy
Drives On Without It**

"We had just hit the desert country when the generator gave out...and then, surrounded by empty miles of sand and sagebrush and cactus, the battery went dead and the motor died," writes Ben Feinstein of Blue Point, Long Island.

"There we were, no one to help us, and night coming. My partner got out the flashlights in case we might need them, and I had a wild idea.

"I took the five cells out of my long-range 'Eveready' flashlight, taped them together in series, held a wire from the ignition switch firmly against the positive pole of the top cell, grounded the bottom cell on the emergency brake handle. My companion cranked the motor and she caught...and those five DATED



'Eveready' batteries took us over thirty miles of desert that night."

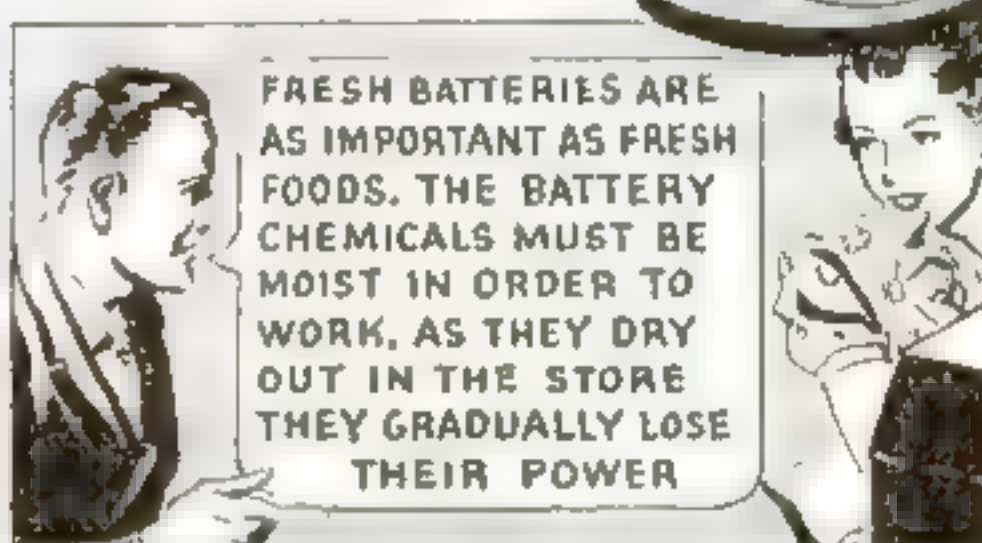
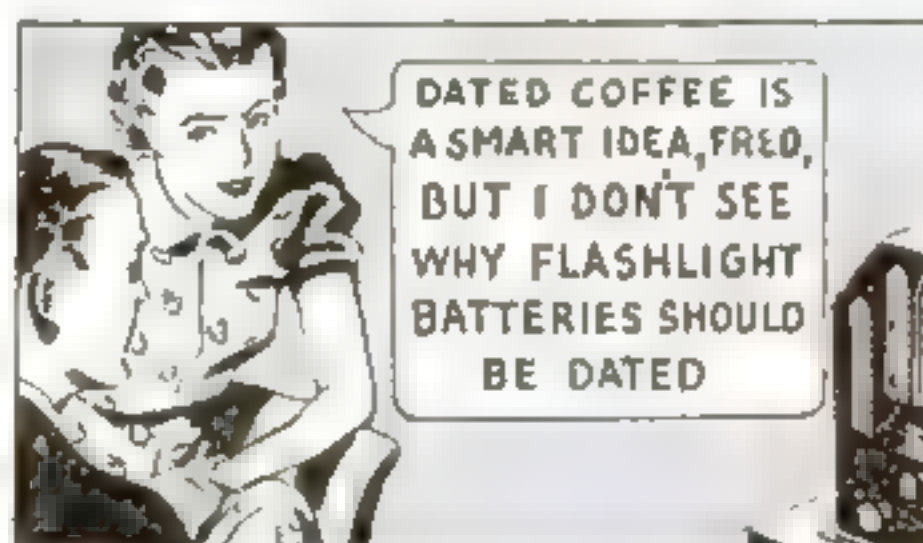
"Believe me, I know now what it means to be able to buy batteries when they are still fresh—not stale and dried out from standing on a dealer's shelf. And here's telling everybody that 'Eveready' batteries last longer than any others.

(Signed)
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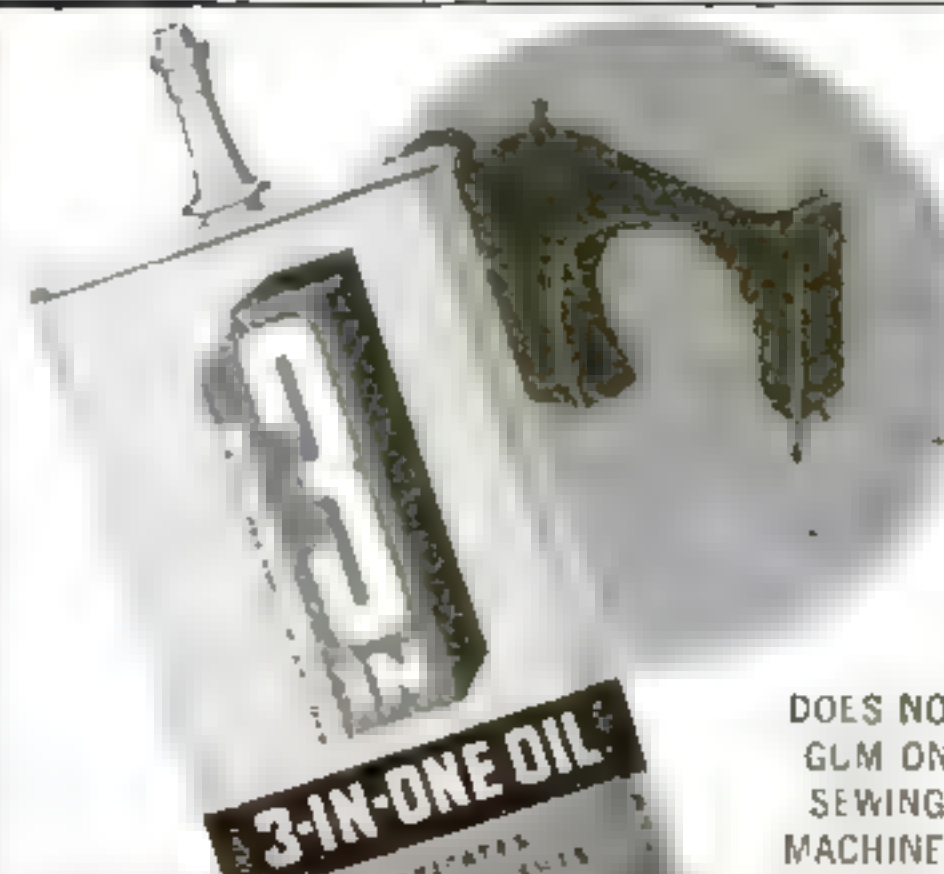
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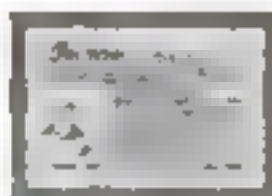
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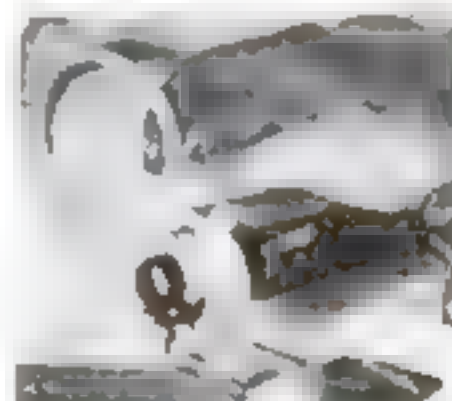
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FLATIRON HANDLE WOUND WITH RUBBER TUBING

FLATIRON handles are greatly improved if they are wound with a layer of small rubber tubing, which makes a cool as well as a soft and resilient cushion for the hand. For satisfactory results the tubing must be made of a good quality rubber with an outside diameter of approximately $\frac{1}{4}$ in. and an inside diameter not less than $\frac{1}{8}$ in. An average flatiron requires about 6 ft. of tubing.

The ends of the tubing may be fastened in any one of a number of ways. Tacks or small wood screws may be driven through the ends of the tubing into the handle, the ends may be tucked under the last turn or two, or the ends may be pushed into holes bored near the ends of the handle, as in the case of the electric flatiron illustrated at the right.—
EDGAR L. BROKAW



The end is pushed through a hole in the wooden handle

MAKING PICTURE FRAME

(Continued from page 117)

progressing. When the string is long enough, the head of the first piece has to be squeezed through the last slot until it clicks. Be careful not to get a twist in the string when joining the ends. The total number should be a multiple of four, but by adding one, two, or three pieces, it will come together naturally.

The center board should be about $\frac{1}{2}$ in. thick, but is more easily made by gluing two thinner pieces together, the back piece having a larger opening than the front. This saves cutting a rabbet for the glass. This piece may be any shape, so long as the corners, if any, are well rounded. It must, however, fit tightly into the corner formed by the interlocked pieces, so its edge should be beveled to about the same angle as that at which the pieces lie. Try for fit with a piece of cardboard before cutting the wood.

The picture-holding board just snaps into position. Twist the circle of pieces back with both hands and drop the center in; they will then close over it again. If it is not a tight fit, you may need some strings across the back to hold it.

If you wish to varnish the frame, this should be done before putting the pieces together.—P. O'N.

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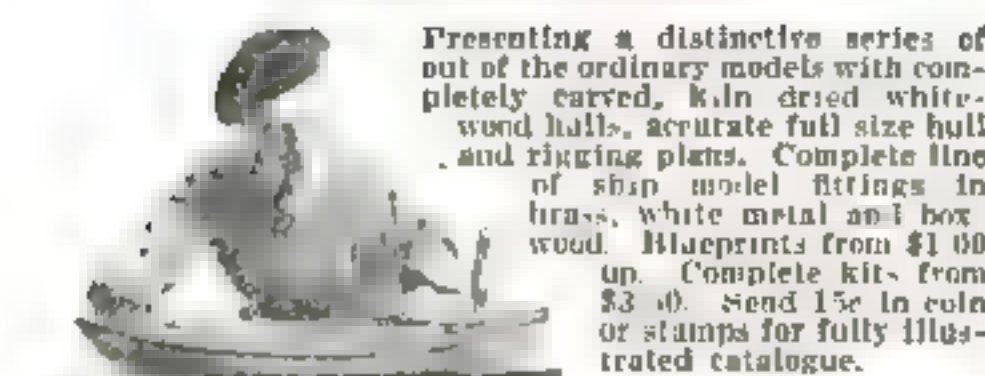
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Models I Have Built—

Wooden Aircraft



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174 Worth Street New York, N. Y.

GIANT X-RAY MACHINES AID WAR ON DISEASE

(Continued from page 29)

crystalline form, however, and cannot be used in the analysis of liquid chemicals.

From Stockholm, Sweden, comes word of a seemingly magical method, devised by Dr. L. V. Hamos, for the analysis of metals by use of the X ray. This scientist laminates paper-thin strips of metal together and then directs a beam of X rays against one edge of the "sandwich." Secondary X rays, he reports, are formed by the bombardment, and these rays are the clues to the chemical composition of the metal from which they come. By means of a crystal of pure salt, shaped into the form of a cylinder, Dr. Hamos analyzes the secondary rays. In demonstrations, he has been able to identify the chemical constituents of strips of metal, only 1/250 inch thick. The value of his discovery lies in its ability to give a rapid analysis of metals and metallic ores without changing the physical appearance of specimens.

FOR a long time, paint chemists have known that X rays have the power of changing the character of pigments. The whole question of how much radiation is necessary to produce such an effect has been studied in recent months as the result of an unusual occurrence at an art gallery in Germany.

A few weeks after a painting had been X-rayed to determine its authenticity, the pigment appeared to be attacked by a sort of "cancer" which spread to all parts of the canvas. What had happened?

Until the answer to that question was found, other German museums refused permission for anyone to X-ray paintings. In a number of laboratories, scientists set to work on the problem. Their report, made not long ago, reveals that, to injure the pigment, the rays must be from 10,000 to 100,000 times as strong as is necessary to penetrate the layers of paint on a canvas. When weaker rays are used, no damage results.

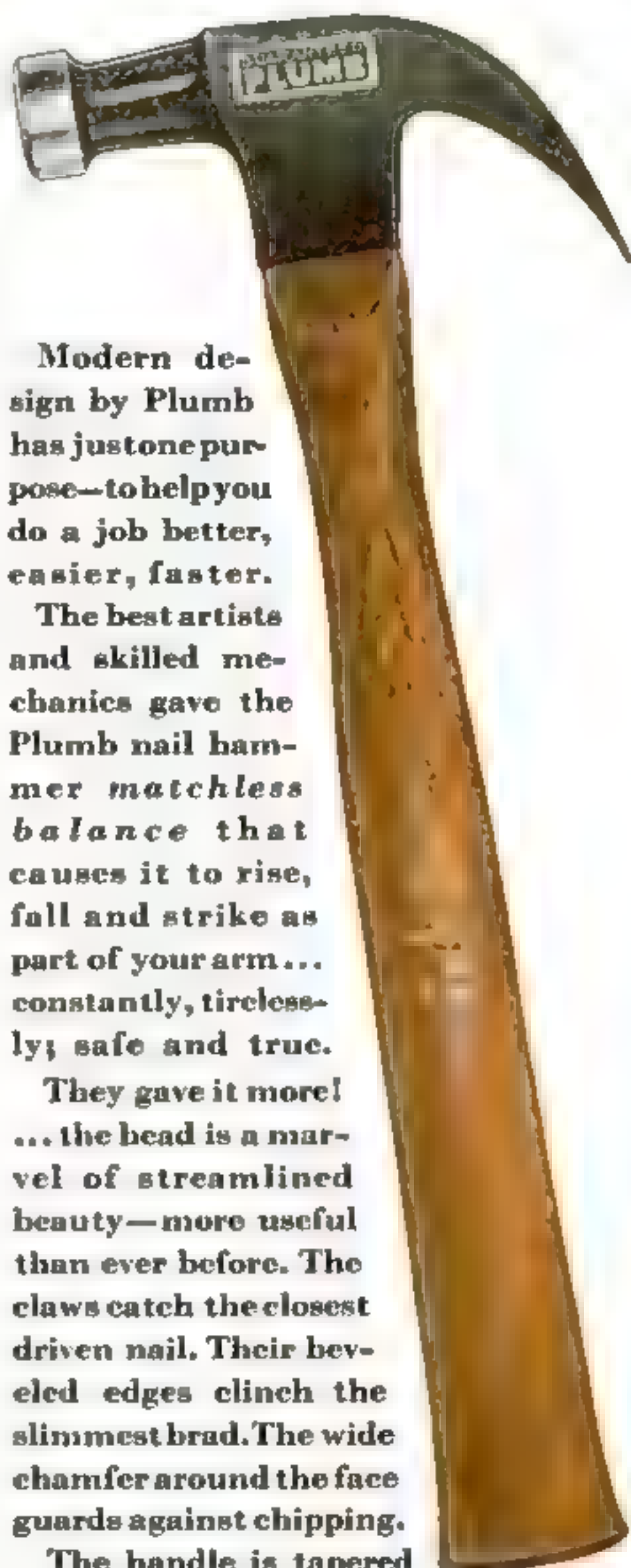
Another problem, upon which scientists have worked for years, was solved recently at the U. S. Bureau of Standards, in Washington, D. C. To measure exactly how strong rays must be to penetrate to a given depth within the human body, radiologists long have sought a fluid which would absorb radiation exactly as the body does. Water meets this requirement, but it conducts electricity too freely to permit accurate measurements with X-ray meters.

FOR a year and a half, Dr. F. L. Mohler and Lauriston S. Taylor, of the Bureau, worked on the problem. Scores of involved chemical mixtures were tested and discarded. Finally, they hit upon exactly the fluid they sought: a mixture of carbon bisulphide, ligroin, and tetra-hydronaphthalene. To complete their work, they evolved a new and more satisfactory meter. It consists of a quartz slab two and a half inches square and a third of an inch thick, hollowed out with a diamond cutter and carrying hair-thin wires of aluminum. Attached to a galvanometer, the meter shows exactly how much radiation reaches the depth to which it is sunk in the fluid, or, conversely, how strong the rays have to be to reach that depth or a similar depth in the human body. This advance, achieved in the Washington laboratory, not only solves a long-time puzzle but increases the safety and effectiveness of X-ray treatments.

Three other developments have resulted in better and cheaper radiographs, or X-ray pictures. One, the introduction of large paper negatives, enables the expert to X-ray as many as 600 chests in one day. Another advance is a machine which produces full-length radiographs of the (Continued on page 120)

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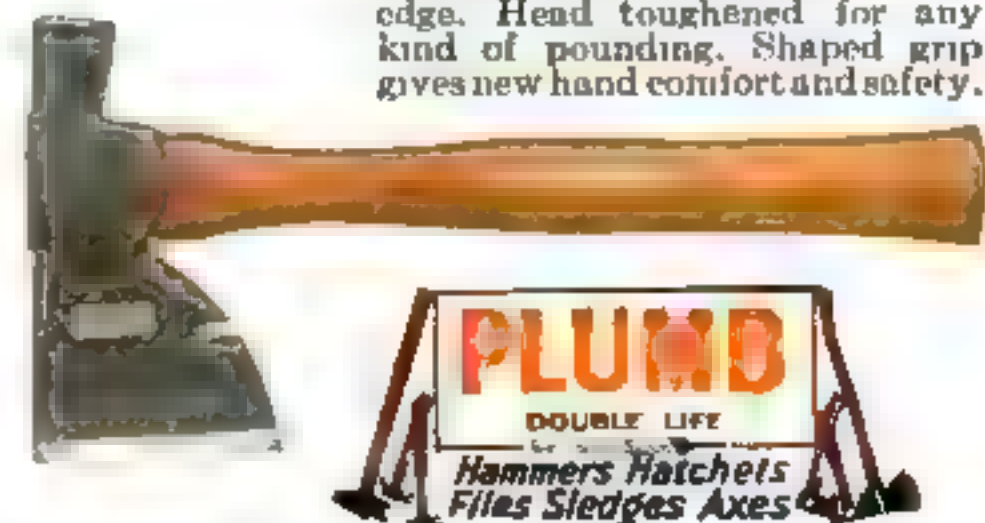
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GIANT X-RAY MACHINES AID WAR ON DISEASE

(Continued from page 119)

body. The third innovation, the coating of the skin of the face with a substance which is partially opaque to the rays, produces combination skull-and-profile pictures.

By the use of new fluoroscopes, or viewing screens, three physicians at Lenox Hill Hospital, in New York City, have succeeded in obtaining clear X-ray movies with ordinary sixteen-millimeter home movie cameras. The fluoroscopes are coated with either a zinc sulphide solution, producing a brilliant bluish image, or with a cyanide preparation, providing a bright greenish yellow image.

FOR ordinary subjects, the physicians found, they could shoot at the regular speed of sixteen frames a second. Unusually thick subjects sometimes required a slowing down to ten or even eight frames a second. On the other hand, the physicians discovered they could record fully-exposed pictures at twenty-four frames a second when X-raying exceptionally thin patients. At this speed, it was possible to watch the action of all four chambers of the heart. By cementing strips of such X-ray films into loops, they can be run through the projector over and over again to show medical students just what happens inside the body when a patient breathes, moves, or swallows.

Depth, as well as width and height, is given to the internal organs of the body when viewed by means of a new X-ray apparatus designed in Russia. The observer looks at twin fluoroscopes through a device like the old-fashioned parlor stereoscope, and sees the organs apparently in three dimensions.

The most striking advance toward clearer images and better X-ray pictures is a German invention, known as the "tomograph." It enables the physician to obtain "cross-section" pictures at any desired depth within the body. The lungs, for example, can be recorded without being largely hidden by the ribs, as is the case with the ordinary chest radiograph. Also, by making cross-section pictures at varying depths, the exact point where a bullet has lodged, or where an infection has begun, can be determined.

The principle upon which the tomograph operates is one that is well known to photographers. When long exposures are made with a still camera, stopped down to the smallest diaphragm opening, objects that pass rapidly in front of the lens either are not recorded at all or are shown as faint blurs. The tomograph is mounted so the upper part swings in an arc like an inverted pendulum. While the picture is being recorded, parts of the body not in the layer being photographed move more rapidly past the machine than the cross section, which is fully exposed, and consequently do not show in the negative.

AT WASHINGTON UNIVERSITY, St. Louis, Mo., two scientists have developed a new "Venetian-blind" technique for studying waves of motion in the human organs. Dr. Wendell G. Scott and Dr. Sherwood Moore, the men who carried on the experiments, developed a heavy lead shield holding a series of parallel slits. This shield is placed between the X-ray machine and the film. The resulting radiographs of various organs in action enable the scientists to analyze the waves of movement and to detect improper functioning.

Thus, hardly a week passes by without some discovery or invention giving us new insight into or new mastery over these mysterious rays which a German physicist discovered by accident some forty years ago. Outstanding in this story of widespread advance, however, is the coming of the X-ray giants, the 1,000,000-volt machines which promise dramatic possibilities for the future.

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[illegible]

(Continued from page 48)

A. Almost any tourist camp will take in a trailer. Country filling stations are often glad to let you park in the yard, if you buy gasoline the next morning. If you want electric connections, however, it is a good idea to plan your trip in advance so you will reach a regular trailer camp each night.

Q. Can you park on city streets?

A. Anywhere that there is space enough to get in and out. Usually, when you stop to make purchases, it is best to go beyond the main business district and to have either the nose of your car or the rear of the trailer at the corner of a street or alley. This keeps you from being blocked in by other cars parking close in front or behind. Always allow yourself all the room possible in maneuvering a trailer.

Q. Are any roads closed to trailers?

A. Only a very few boulevards and parkways in the biggest cities.

Q. Can you get on ferries?

A. It was our experience, during the trip, that any ferry that would take trucks would take trailers.

Q. How much does a trailer cut down your gasoline mileage?

A. It probably reduces it from two to five miles a gallon. During our 4,671-mile tour, we averaged eighteen and a third miles to the gallon of gasoline. A few side trips were made with the trailer left in camp. But, on the other hand, we were driving a new car that had just finished its first 500 miles.

Q. Is the trailer hard to attach and detach?

A. Not at all. Anyone can do it in five minutes.

In fact, that was the first thing the dealer demonstrated when he delivered the trailer. He inserted a small crank in a slot, cranked down a post that supported a caster wheel on the trailer. Then he disconnected the electric wires and the hose for the vacuum brakes, and removed a spring clip and two steel pins and a block, hollowed out in the middle. This permitted the pear-shaped knob on the hitch attached to the car, to slide out, and the trailer and automobile were detached. In coupling them up again, the car is backed so the knob slides into place, the block, pins, and clip are slipped into their respective holes, and the connection forms a ball-and-socket joint which permits making relatively sharp turns to right or left.

IT HAD grown so dark when I slid into the driver's seat for my first and only lesson that I had to switch on the lights. Twelve hours later, I knew, I would have to steer through the streets of New York, the second biggest city in the world. I shifted into low and let in the clutch. We started slowly. I could feel the drag of the one-ton trailer. But, once we began to roll, we picked up speed rapidly. In getting started with a trailer, you stay in low gear longer, but after you get going you drive just as you would with the car alone. On an open highway, you can step on the accelerator and pass another car without the least difficulty. I talked to one man who drove across the Tamiami Trail, from Miami to Fort Myers, Fla., a good part of it at sixty-five miles an hour. I have heard of other trailers making eighty miles an hour along deserted highways.

Swinging wide on the turns and craning my neck from side to side, I circled the block twice and came to a stop, still intact. An accessory that helped, and is an absolute necessity in trailer driving, was an outside rear-view mirror. It enables you to see traffic approaching from the rear which otherwise would be hidden by the trailer. When the sun is on your right, *(Continued on page 122)*

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I LIVED IN A TRAILER

(Continued from page 121)

you can often catch sight of the shadows of cars coming from behind before you can see the cars themselves in the mirror.

The most difficult part of trailer driving, the dealer explained, is backing. You have to remember to turn the wheels of the car in the opposite direction from the usual. This is because the car, when backing, acts in the manner of a boat's rudder. Once you get onto it, he assured me, it's easy. To demonstrate, he backed the car and trailer into the narrow driveway. Then he went away, leaving me assailed by many doubts.

We hurried through supper and commenced loading the trailer for the trip. We stowed away boxes of matches, bars of soap, dish cloths, knives and forks, paper plates, flash lights and extra batteries, a small broom, a garbage pail, and armloads of miscellaneous items. We stuffed the closets with old clothes and new clothes; we packed the drawers with bags of salt and sugar, packages of oatmeal and cookies, cans of soup and beans and meat and vegetables. It was easy to see why trailer travelers are dubbed "tin-can tourists."

WHILE this was going on, we were keeping open house for neighbors who wanted to see what a trailer looked like inside. Throughout our trip, we found this intense interest wherever we went. Chauffeurs and taxi drivers, farmers and storekeepers plied us with questions every time we stopped. Often it was difficult to get away from a filling station, because the attendant was planning a trip himself as soon as he could buy a trailer, and wanted to know all about the costs and other details.

Our maps had been marked and our routes laid out. They would take us past places we had always wanted to see: Kitty Hawk, the wind-swept dunes where the Wrights first flew; Daytona Beach, where Sir Malcolm Campbell flashed over the sea-packed sand at 276 miles an hour; the Everglades, the Great Dismal Swamp, along trails followed by Daniel Boone, George Washington, Grant, Lee, and the Spaniards under Ponce de Leon.

As a final step, we checked over everything. There was a fire extinguisher, a first-aid kit, a carton of common drugs. The car was tuned up. All the spare parts were safely stowed away in the trunk. Our money was in travelers' checks. Our automobile liability-insurance policy carried a rider protecting us with the trailer attached.

There were two last-minute bits of excitement. One was when we discovered a stow-away. In one corner of the trailer, Tarzan, the family kitten, had curled up and gone to sleep. The other was when we found—believe it or not—that we had forgotten the can opener.

It was ten o'clock when we finished our inspection and locked up the car and trailer. Everything was ready for the start. Before daylight, the next morning, our adventure would begin.

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(Continued from page 69)

prints, and other objects directly under the objectives of the microscope.

The tubes to carry the linen-counter objectives are made by rolling pieces of gummed package-sealing tape around a piece of one-inch dowel rod until the required thickness is obtained. The first piece of tape applied is, of course, wound around the rod with its ungummed surface next to the wood. Moistened tape is wound around this, and the finished tube slipped off, and then cut to proper length.

THESE tubes are then fitted into the holes in the objective board, but are not glued firmly in position until the mirror box is adjusted in place above them. When the apparatus is complete, the objective tubes are slanted slightly until the two fields, seen through the eyepiece tube, join up in a straight line. The amount of slant is easily found by experiment, with the eye looking into the eyepiece tube.

Before the tubes are placed in the board, the linen-counter objectives are fastened to cardboard disks, pierced with quarter-inch holes, which are glued into the lower ends of the tubes. The folding stand of each magnifier must first be filed away from the square piece of metal which carries the lens. This can then be easily glued to the inside of the disk, with the lens coinciding with the hole.

This objective, together with the eyepiece lens above, gives a magnification of about twenty times, which is the one used in the best professional bullet-comparison microscopes. Its field is, however, too small for use in examining fingerprints or typewriting. For these purposes, an objective of larger field and lower power must be provided.

This is done by making a second "objective board" in which are mounted two lenses of about three-inch focus. These are obtainable also in ten-cent stores. They come provided with a paper cutter and rule as a handle, as shown in one of the photographs. This low-power objective board does not require paper tubes to support the lenses. These are fitted directly into the under surface of the board, and glued in place. This objective board is of course provided with a thumb set screw, and is interchangeable with the higher-power objective board. Quarter-inch holes are drilled into the upper surface of each to receive the dowel-rod lugs fastened to the back of the mirror box and keep it in position.

The construction of the mirror box presents little difficulty. Simply cut the bits of mirror with a wheel-type glass cutter and build the mirror box as shown in the plan.

ONE point requires attention. After the mirrors and their supports are glued into their approximate position, fit the entire mirror box and eyepiece in place on the objective board, and focus upon some pencil crosses on paper under the objectives. You will thus be able to shift the mirrors slightly until the two half fields are equally illuminated. This is also the time to adjust the slant of the objective tubes until the two half-fields join up properly in the eyepiece and are both in sharp focus. When these adjustments are satisfactory, the parts should be glued and allowed to dry in position.

It is then a good plan to add four quarter-inch dowel rods as braces for the eyepiece tube, as shown in the photographs. Before adding these, you may find it necessary to slant the eyepiece tube very slightly to get the field well centered.

The small reflectors, which aid in illuminating the sides of the bullets away from the lamp, are made by bending two squares of bright tin or alum- (Continued on page 124)

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BETTER FARM ANIMALS PROMISED BY NEW TESTS

(Continued from page 57)

Through the following decade, the farm advisers toiled long and hard. Day after day they went out into the field, urging farmers to join cow-testing associations, helping them to select better bulls and to weed out inferior ones. Proper diets began to fill out underfed cows. Expert medical attention, sanitary precautions, and quarantine measures helped to keep down bovine diseases. Scientific standards began to replace guesswork, and cows that did not measure up to them were gradually eliminated. Blood from pure-bred, prize-winning dairy bulls began to filter into the herds of the state.

BEFORE long, results began to be apparent. By 1926, butter-fat production had shot to 225 pounds. More than 5,000 inferior cows had been discarded and 50,000 put under test. Enthusiasm mounted as rich milk poured in to swell profits. By 1930, 15,000 cows had been weeded out and 100,000 had been brought under regular scientific test. When the 1930 census figures were released, an amazing thing was discovered. Average butter-fat production for each cow had jumped to 265.6 pounds—six tenths of a pound more than the goal set a decade before!

Not only at the University of California, but also at many other centers in the United States, scientists are delving into the secrets of breeding and raising superior live stock. At the U.S. Bureau of Animal Husbandry farm at Beltsville, Md., experts are tackling one of the oddest problems ever presented to agriculturists: How can we prevent hogs from getting sunburn? It seems that Danish pigs, introduced recently into the Middle West, proved very satisfactory, except for the fact that their tender skins blistered under the hot American sun. So experimenters are now striving to cross the blond Danish pigs with "English blacks," and so produce a strain of brunets that would be resistant to sunburn.

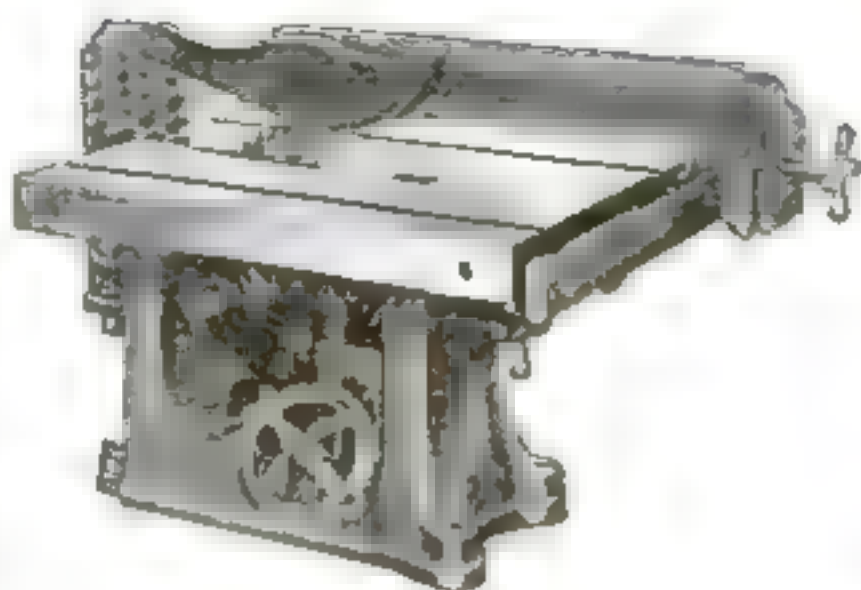
Draft horses are bred primarily for their pulling power. To test this factor, a special "horse dynamometer" devised by farm advisers was demonstrated recently. Mounted on the back of an auto truck, this apparatus consists of a number of disk-shaped lead weights which are attached to a harness by means of pulleys and steel cables. Teams of prize draft horses, straining their powerful muscles, tug at the harness to raise the disks vertically from the floor. By changing the number and size of the weights, experts can accurately gauge the maximum pulling power of the animals.

FOREIGN scientists also are working industriously to apply modern breeding principles to their own problems. Japanese experts are experimenting to produce strong, healthy horses that can withstand the rigorous Manchurian winters and still be small enough for the Japanese to ride comfortably.

Chinese farmers prefer heavy-horned cattle to horses for farm work, for such an animal can not only plow but produce milk and meat as well. By crossing imported American short-horn bulls with the native cows, experimenters hope to produce an animal far superior to the Manchurian cow, now a small creature yielding only about three gallons of milk a day.

These are some of the phases of the world-wide efforts of science to untangle the snarled complexities of animal life. When, at some future time, these findings are all put to practical use, the world may see a breed of super-creatures—"streamline" animals supplying a new abundance of food and capable of a working efficiency undreamed of at the present time.

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NEW MOLDING MATERIAL FINDS MANY ODD USES

(Continued from page 51)

and catches any drippings. Soda straws in his nostrils enable him to breathe while you apply thin layers of the material, one by one, over a rough frame fashioned of wire to support it. When the last has hardened, which takes but a short time, the solidified mold is grasped at the edges and carefully lifted off. It bears the imprint of every detail of the subject's features.

Next you melt up a small quantity of the "positive" material, an opaque, waxlike substance supplied in tints to match various shades of complexion. This is brushed or poured into the "negative" mold to form a thin shell. When it has set, it is backed with the reinforcing plastic. Remove the cast from the mold, and you will have a likeness of photographic quality that will endure through the years.

IF A hobbyist chooses, he can enhance the appearance of the mask by hand-carving the eyes open, by gluing on real hair to represent eyelashes and eyebrows, and by tinting with oil colors. Since "positive" moulage takes electroplating, the finished mask may be given a striking appearance with a coating of silver or of copper.

Suppose you want to present masks of yourself to each of half a dozen relatives. You need make only one "negative" mold. The six "positives" are then cast in turn; as each one is withdrawn, a dipping in water is the only preparation that the mold needs before the next casting.

When the "negative" mold has served its purpose, it is broken up and the material is used over again. For an amateur of limited means, this is an especially important point. Four pounds of the "negative" plastic, enough to make a face mask, costs from six to twelve dollars. The same material may be melted down and used again from 100 to 300 times however, reducing the cost of a single "negative" mold to a few pennies. The "positive" material is cheaper by the pound and much less of it is required, so the total cost of a face mask amounts to less than a dollar. Even the initial expense for materials becomes moderate when it is shared by a group of hobbyists. A still more modest start may be made with a two-pound can of the material, enough to cast a human hand or a small statue, and many beginners acquire practice in this way before going on to more ambitious projects.

Starting in a small way from its invention a few years ago, moulage has made a permanent and valued place for itself in the realms of science, art, and industry. Now, with its increasing use by amateurs as well as professionals, moulage may soon be performing many new and as yet undiscovered tasks in aid of science.

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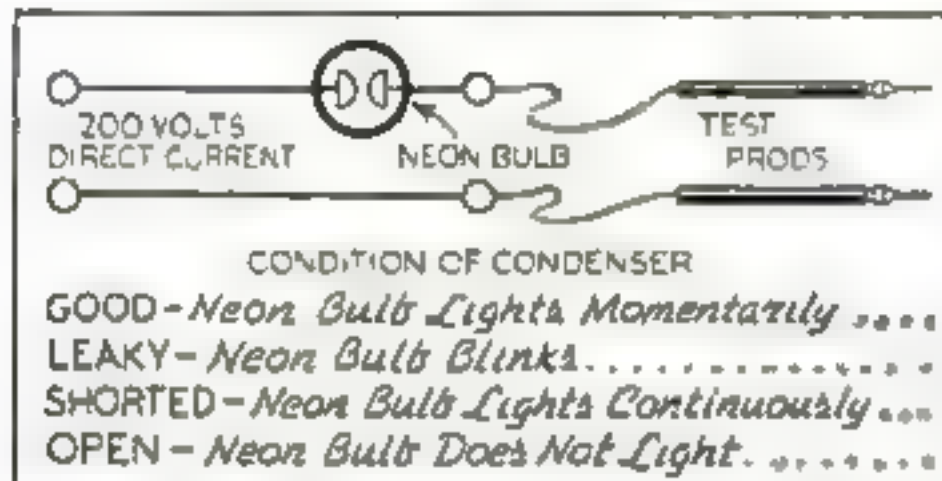
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RADIOTROUBLE-SHOOTING

(Continued from page 75)

approaching oscillation) usually can be eliminated by connecting a small mica condenser across each side of the high-voltage secondary of the power transformer. As electrolytic condensers are likely to be used in the power supply, it is also advisable to use a small mica condenser across the first condenser next to the rectifier. Sizes ranging from 0.005 to 0.02 mfd. will suffice. Similar condensers used across the primary will also prevent noise from entering through the power line.

Although it is possible to wire a radio circuit completely and remove any "kinks" or troubles without any special meters, the work will be simplified if the radio experimenter



How a plain neon lamp, wired to a 200-volt direct-current supply, makes a condenser tester

provides himself with a voltmeter, an ohmmeter, and a condenser tester.

Suitable voltmeters are easy to obtain. If you at one time owned a commercial battery-operated receiver, and have it stored away in your attic, you will find that its panel boasts a miniature meter that will serve

With a few alterations, one of these inexpensive meters also can be made to serve as a double-range ohmmeter. How this is done is shown in the illustrations. First obtain a used voltmeter having a scale which reads from zero to five or from zero to seven volts. Then, by carefully unscrewing the back of the case and loosening a small bolt, remove the built-in resistor spool. This resistance looks like a midget magnet coil.

After disconnecting the outer end of the wire wound on the resistance spool, unwind enough of the wire to bring the total resistance of the coil down to about 340 ohms. By putting a three-volt battery in series with the meter and the spool, and removing wire until the meter needle reads off the scale, this can be done without the aid of an additional meter.

ALL that remains, then, is to connect the altered resistance into a circuit consisting of a "C" battery, two forty-five-volt "B" batteries, a 6,000-ohm resistance having a sliding tap, a 200-ohm rheostat, and a pair of test prods, as shown in the diagram. The voltmeter is now an ohmmeter and the battery-switch circuit provides two scales—from 0 to 10,000 ohms when the "C" battery is connected into the circuit, and from 0 to 150,000 ohms when the "B" batteries are used.

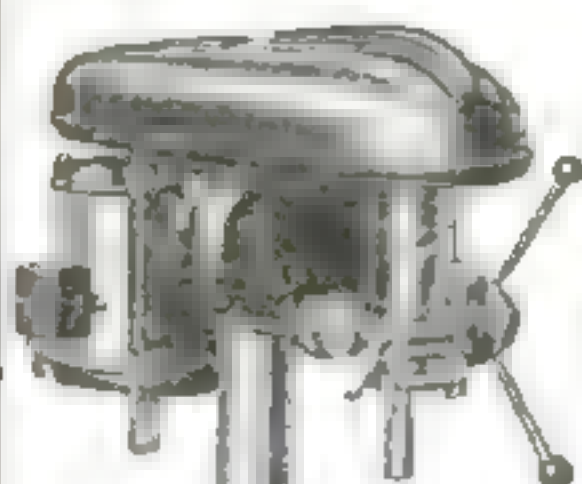
The rheostat is provided to make it possible to allow for any reduction in the voltages of the batteries due to use. For this reason, the meter must be adjusted each time it is used. This is done by touching the two test prods together, throwing the switch for the scale desired, and then regulating the rheostat to bring the needle to the zero reading.

When the meter is first made, it will be necessary, of course, to calibrate a suitable scale. This can be done easily by testing known resistances of various sizes and marking the position of the needle in each case on a dial.

In testing fixed condensers, no meter is required. A simple tester, shown above, can be made simply by wiring an ordinary neon light into one leg of a pair of wires leading to a 200-volt direct-current source (a "B" supply will serve).

New Tools for 1937

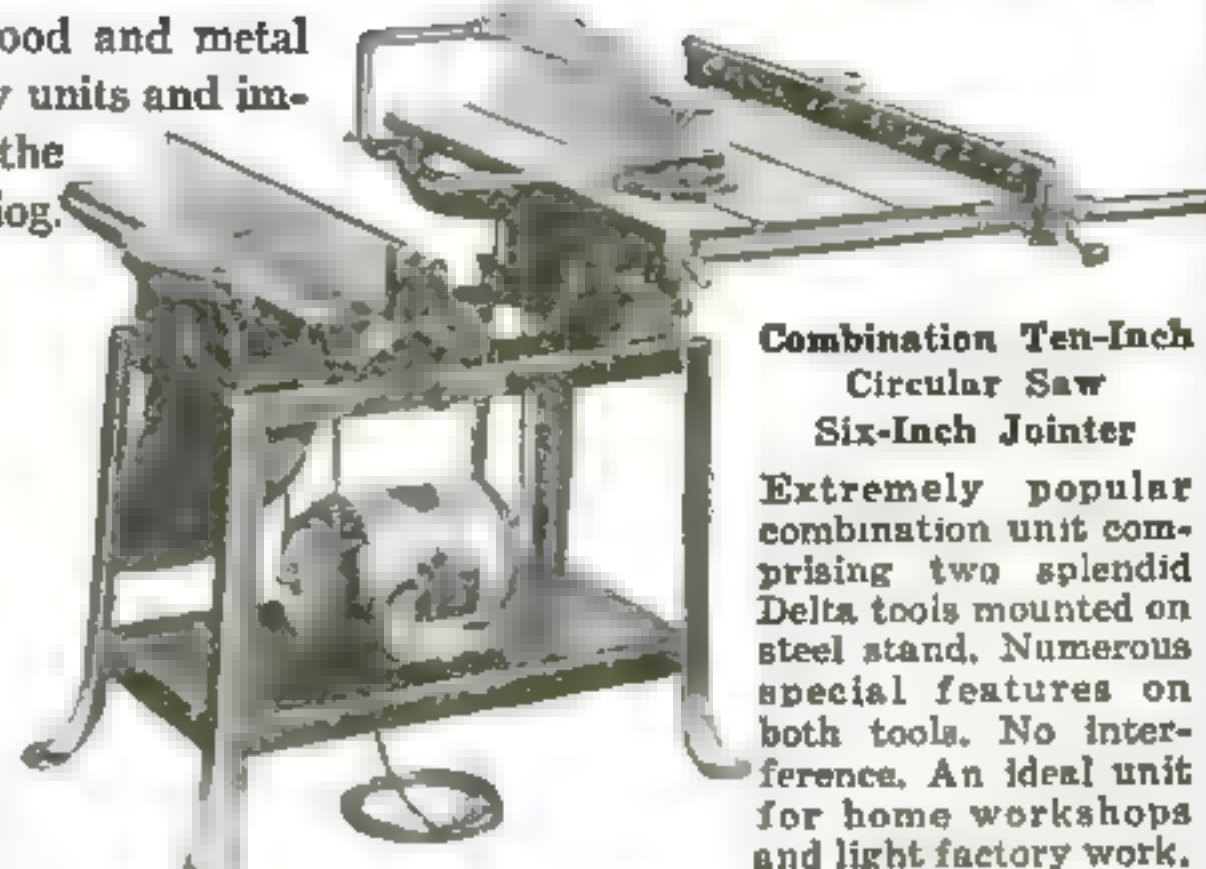
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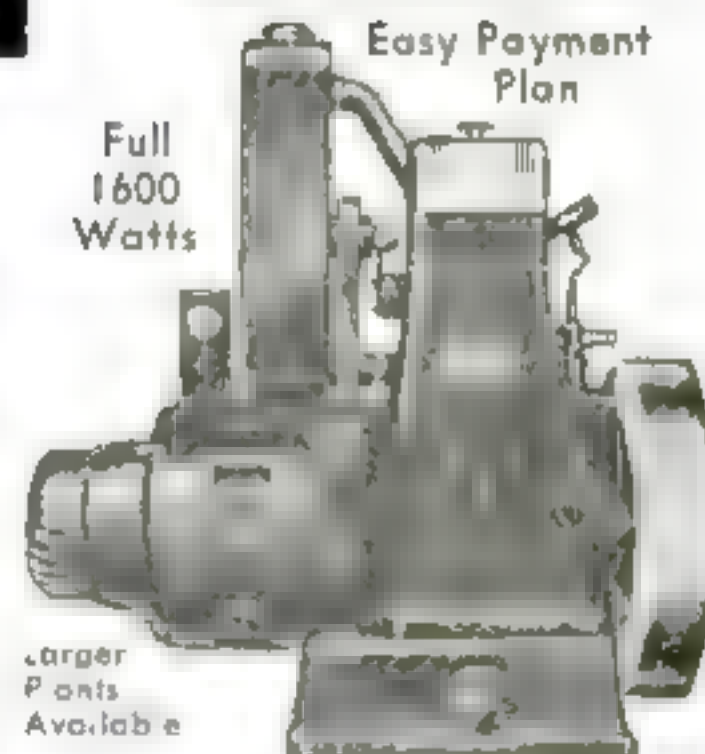
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TIN-CAN CHEMISTRY

(Continued from page 71)

them. The copper is collected when the cans have been completely converted. The iron in the cans takes part in the process, behaving in just the same way as the tin.

Tin precipitates a number of metals besides copper from their salts, including mercury, silver, bismuth, gold, and platinum. Try suspending a piece of tin foil, rolled into a stick, in a solution of silver nitrate. Soon you will find it covered with pretty crystals of metallic silver.

When metallic gold is liberated from a solution by the action of tin, the finely divided colloidal particles take on a shade ranging from red to purple. Gold in this peculiar form, known as "purple of Cassius," is used for gilding porcelain.

ZINC is one of the metals that tin does not displace; instead, zinc will deposit tin from a solution. Cover a piece of tin foil with strong, hot hydrochloric acid and it will dissolve, giving you a solution that you can use in this and other experiments requiring a tin salt. Hydrogen gas escapes, and the remaining liquid contains stannous chloride, or tin chloride. When you insert a rod or strip of zinc in this solution, beautiful, shiny crystals of tin should plate out upon the zinc. If they do not, and bubbles of hydrogen gas appear instead, the solution contains too much acid and is attacking the zinc.

Common pins, which are made of brass wire, are coated with tin by the reaction just described. When the pins are shaken in a solution of a brass salt, the zinc in the brass displaces some of the tin. The latter is deposited in metallic form upon the pins, giving a tarnish-resisting coating.

Metallic tin acts upon a solution of ferric chloride, one of the forms of iron chloride, in an interesting way. If you leave a sheet of tin overnight in a small quantity of the iron solution, the tin dissolves. At the same time, the ferric chloride is "reduced" or transformed into ferrous chloride, another form of iron chloride, as you can tell by the disappearance of the original yellow color of the solution.

"Tin Lizzie" may be an undeserved epithet for a car, but an expert has estimated that the average automobile does contain no less than seven and a half pounds of tin, mostly in the form of solder and bearing metal. And these are but two of the hundreds of valuable alloys made from tin.

ORDINARY solder consists of a half-and-half mixture of tin and lead, and melts at a temperature considerably lower than the melting point of pure lead. When tin is alloyed with various combinations of bismuth, cadmium, lead, and mercury, however, it forms a peculiar and interesting set of alloys that liquefy well below the boiling point of water! Hence they are used as fusible links in automatic sprinkler systems; in case of fire, the link melts and allows a spring valve to open, releasing a flood of water. How to make a working model of such an apparatus was described in an earlier article of this series (P.S.M., Apr., '35, p. 54).

Though tin is a soft and malleable metal, it has a hardening effect upon soft copper. Bronze, gun metal, and bell metal are the results of this fortunate union. With zinc and copper, tin combines to make many types of brass; with copper and antimony or lead, britannia metal and pewter; with lead and antimony, type metal for printing; and with zinc, antimony, and various other ingredients, Babbitt metal for the bearings of machinery. Only iron is more versatile than tin at entering into useful combinations with other metals.

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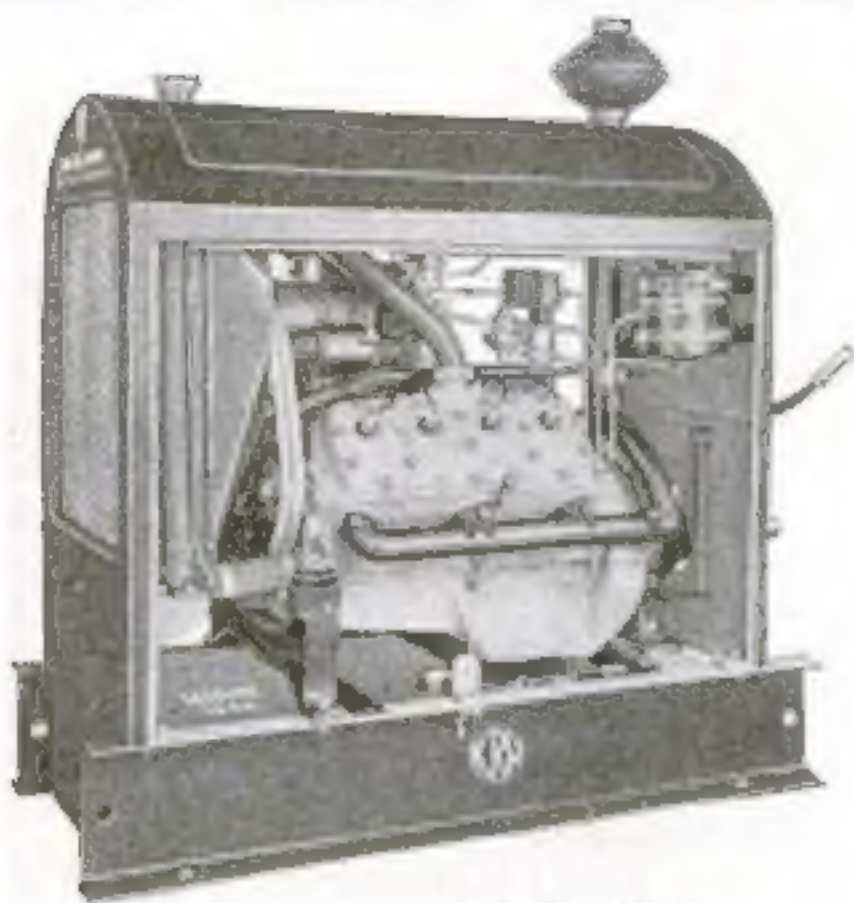
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YOUR AIR CLEANER

(Continued from page 76)

see much sense in that air-cleaner business," Wisner complained, as the two men headed for the river bank. "When you get it fixed up, why not leave off the air cleaner? What's the need for such a gadget, anyway, when most of the roads are concrete and there isn't any dust to speak off? People don't have to breathe through an air cleaner, so why should a motor?"

"I'm ashamed of you, Doc," Gus smiled, as he pulled his fishing rod out of the case and started to put it together. "Have you forgotten all the little hairs inside your nose? They do exactly the same job for the air you breathe that the oiled metal filaments in the air cleaner do for your car's air supply."

THE doctor grunted. "Score one for you, Gus. Of course, that's true. Still, I shouldn't think that the little dust there is in the air these days would do the motor any harm."

"No dust in the air, eh?" Gus countered. "Then what is all that stuff that settles on your car when you get it spick-and-span and leave it standing outdoors—even on a concrete road—for a couple of hours? And if you rub your finger over the hood or the top of a mudguard, you pick up a lot of fine grit that would make a pretty good grinding compound if you mixed it with a little oil."

"Another thing," Gus continued, warming up to his subject, "every time somebody analyzes the carbon that forms in a motor, he always finds that a large percentage of it is road dust. Aside from that, the air cleaner acts as a silencer. Take it off, and the air rushing into the carburetor makes a whishing, sucking, gurgling sound so loud it'll drown out all the other noises in a car."

At this point in Gus's little talk on air cleaners, he hooked a big fish. In the ensuing excitement, the subject was forgotten. It was a lively battle, but Gus finally worked the fish close to the bank where Wisner was standing.

"Net him quick!" Gus shouted. "Feels like the hook may let go any second!"

The doctor was just in time, for the hook snapped loose as the net scooped up the prize.

"Guess we'd better get going now," Wisner suggested, "I want to get in touch with my office pretty soon."

When they got back to the Model Garage, Wisner phoned his office and, as there were no calls, he decided to stay and watch Gus fix his car.

As he had predicted, Gus found the piece of metal in one of the cylinders. Fortunately, it had not scored the wall, so he started to reassemble the head.

"The trouble with this air-cleaner business," he grumbled, as he brought out a new cleaner and tested to see if it fitted properly, "is that more than half the air cleaners on the road today aren't doing what they should. Just because the air cleaner ordinarily doesn't give any trouble, most owners neglect them. The oil gets all dried out, and after that most of the dust goes right through."

"AND what's even worse," Gus went on, "is that some car owners just go on spilling heavy oil into their cleaners without ever giving them a real cleaning out. After a while, the metal filaments get so coated with a caked-on mixture of heavy oil and road dust that they actually cut down the air flow. Then the owner goes around complaining about what rotten gas mileage he's getting, when the only trouble is that his air cleaner is so clogged it's giving the same effect you'd get by running with the choke partly closed all the time. A badly clogged air filter will cut your gas mileage sometimes as much as three or four miles (Continued on page 130)



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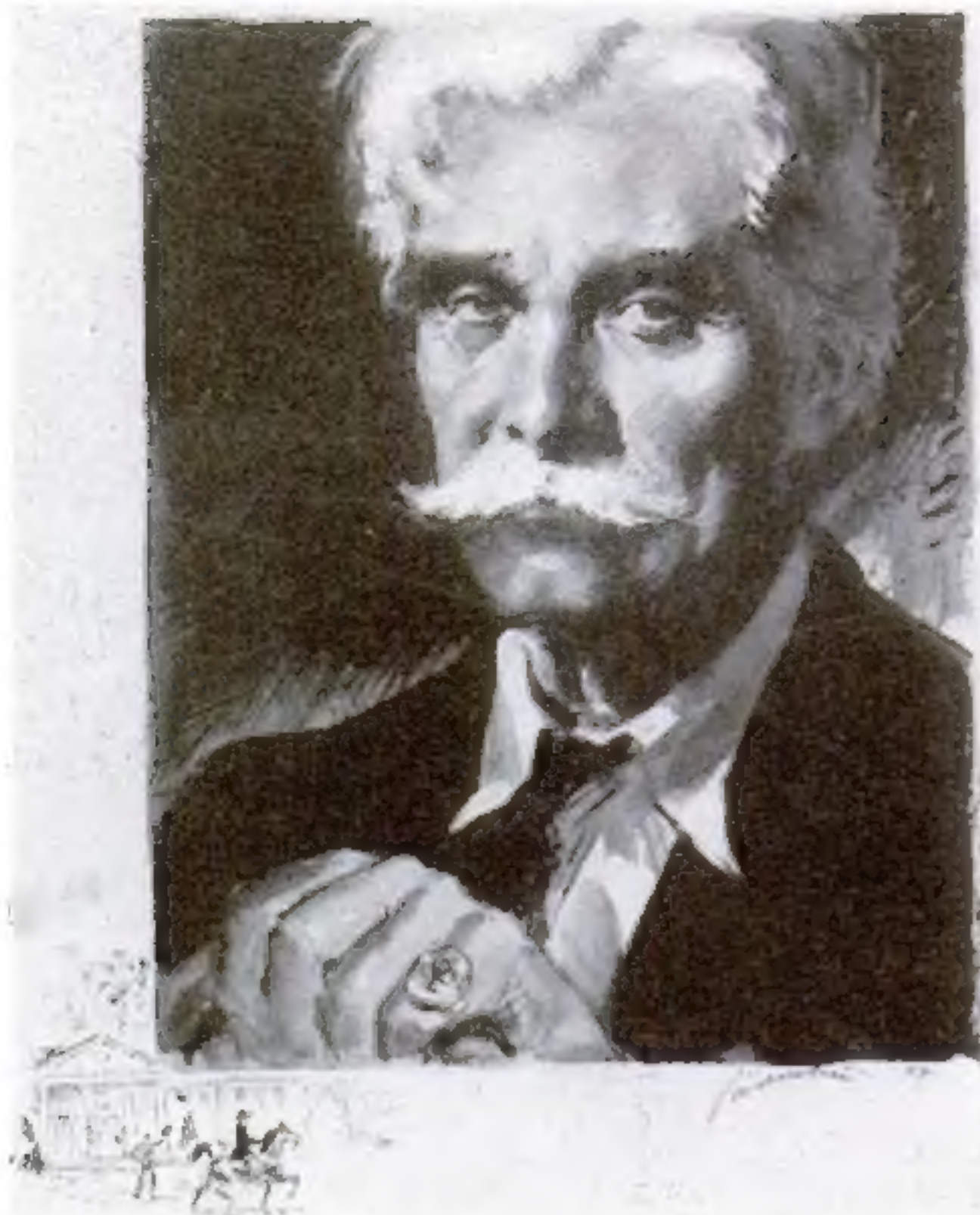
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SCHICK SHAVES

YOUR AIR CLEANER

(Continued from page 129)

to the gallon—and that's a mighty big waste."

"I know the instruction book says to clean it out with gasoline and re-oil it," Wisner commented, "but that strikes me as a pretty messy job. Can't you blow the dirt out with air pressure some way?"

"You can't get it really clean with air pressure," Gus replied. "And the job of cleaning isn't so messy if you go about it the right way. Get yourself a couple of cans big enough to take the air cleaner, and have one of them about twice as deep as the air cleaner is high. Have covers for both of the cans. Put the air cleaner in the shorter can and pour in enough plain gasoline to cover it. If you want to play safe and have no worries about fire, use one of the standard nonburning dry-cleaning fluids instead of gasoline. Let the air cleaner stand in this fluid for five minutes or so and then swish it up and down a couple of times to dislodge all the dirt.

"IN THE deep can," Gus continued, "put enough light oil to cover the air filter. The lighter the oil is, the better. Winter engine oil—S. A. E. 20, or even a lower viscosity, is about right. Dunk the air cleaner in the oil and then, with a piece of string and a short stick, hang it in the upper part of the can overnight so as to let all the excess oil drain away. If you're in a hurry, you can cut the draining time to ten minutes or so, because what little oil runs out after that won't have any effect on the motor.

"It'll take quite a while before the cleaning fluid gets so dirty that it won't take all the dirt out of the air cleaner," Gus continued, "and you'll use so little of the light oil that you'll hardly notice it."

"Sounds like a cinch that way," Wisner agreed, "only I think I'll tie the string onto the air cleaner before I start. Then I won't have to get my hands in either the cleaning fluid or the oil. How often should you do the job?"

"The instruction books usually say every 1,000 miles or so," Gus replied, as he fastened the air cleaner in place and started to put his tools away, "but, of course, it really depends on how much dust you run into, and not on how far you drive. If you're driving in heavy traffic, on roads with dirt shoulders, you pick up dust fifteen or twenty times faster than you do if you drive over the same roads with no traffic."

"Suppose I give the air cleaner a treatment every 2,000 miles if the going is mostly on concrete without much traffic, and cut the intervals down to as little as 500 miles if the traffic is heavy and there is a lot of dust?"

"That's reasonable, Doc," said Gus, as his friend climbed in and started the motor.

JOE CLARK, who had stepped out of his office just before Wisner drove away, was sniffing the air suspiciously.

"I smell fish," he grinned, as he picked up the leaf-wrapped trophy and examined it admiringly. "You old fraud! Now I suppose you'll tell me you pulled this out of Doc Wisner's motor, too!"

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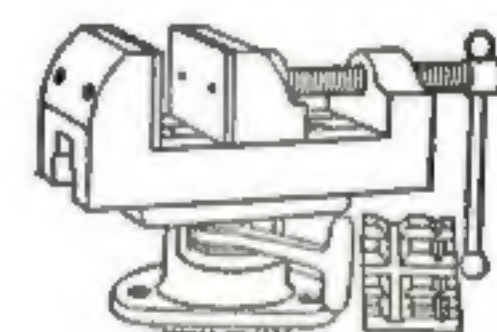
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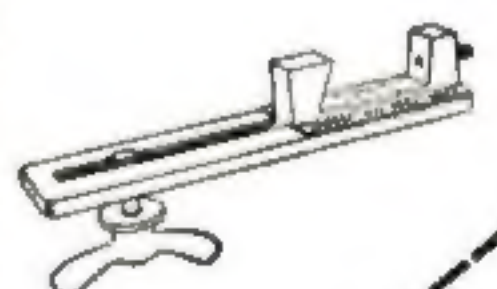


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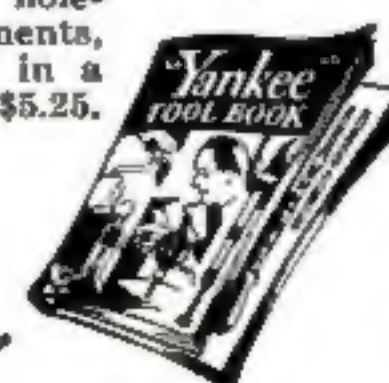
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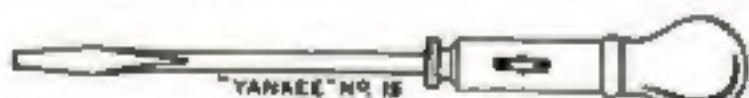


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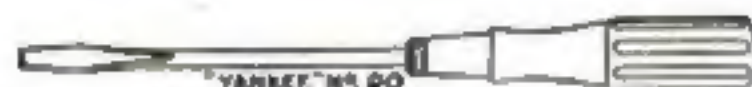
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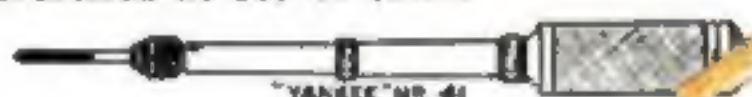
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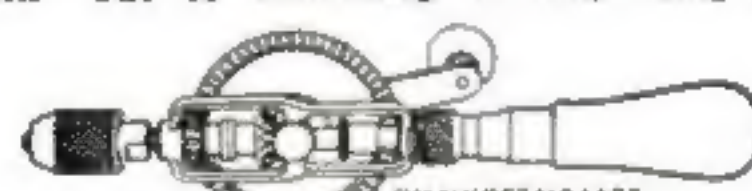
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